DEFENSE INDUSTRY BULLETIN

Volume 2 No. 1 January 1966

IN THIS ISSUE

DEPARTMENTS

DEPARTMENT OF DEFENSE

Publication of

ASSISTANT SECRETARY OF DEFENSE-PUBLIC AFFAIRS

Defense Industry Bulletin Starts Second Year of Publication

The first anniversary issue of the DEFENSE INDUSTRY BULLETIN marks a milestone in our continuing effort to assist American industry in responding to Defense requirements. Thousands of readers have told us it serves a useful purpose. I am pleased with this expression of interest and with the steady growth in the BULLETIN circulation.

Through this publication and other channels of information, we shall do everything possible to communicate our policies and plans and keep industry apprised of our needs to accomplish them.

I am encouraged by the increasing cooperation between the Department of Defense and industry, and I am confident that we can work even more closely together in the future. The DEFENSE INDUSTRY BULLETIN is dedicated to this purpose.

Robert S. McNamara

Secretary of Defense

Procurement Counseling To Be Repeated at Advanced Planning Briefings

Procurement counseling and assistance will be offered for those who desire it as part of the 1966 DOD-National Security Industrial Association Advanced Planning Briefings for Industry. Senior procurement specialists from the Military Departments and the Defense Contract Administration Service will be on hand at each regional meeting to discuss specific procurement program interests and problems.

Also available will be current Invitations For Bid and Requests For Proposal aggregating over $100 million, as well as lists of items for which DOD buyers are seeking additional sources. Other informative material on hand will be Secretary of Defense McNamara's "Posture Statement" before the House Armed Services Committee on the FY 1967-1971 Defense Program and the 1967 Defense Budget. Special attention will be given to small business and labor surplus area concerns and the six DOD programs for those firms will be explained.

Joining the Defense Department will be representatives of prime defense contractors, the Department of Commerce and the Small Business Administration, who will be available to discuss subcontracting opportunities and services available to contractors in the technical, management, financial and dissemination of requirements fields.

The 1966 Advanced Planning Briefings for Industry will be held in the following metropolitan areas on the dates indicated:

March 3-4 Sheraton-Boston Hotel, Boston, Mass.
March 9-10 Dinkler Plaza Hotel, Atlanta, Ga.
March 16-17 Sheraton-Jefferson Hotel, St. Louis, Mo.
April 12-13 Fairmont Hotel, San Francisco, Calif.
April 27-28 Sheraton-Park Hotel, Washington, D.C.

Those interested in attending the briefings may obtain additional information by contacting Mr. Paul Newman, National Security Industrial Association, 1035 Fifteenth Street N.W., Washington, D.C.

Security Classification "When in Doubt, Find Out"

From time to time contractors have expressed a reluctance to question classification guidance received with a proposal or a contract, or to request elaborations and explanations for fear of antagonizing the "customer." Proper classification is the touchstone of security. To ensure integrity of the system and to reduce security costs to a minimum, it is essential for the contractor to be able to identify precisely and accurately the items of information which require classification so as to figure out what documents and hardware must be classified.

Contractors must rely on the guidance set forth in DD Form 254, "Security Requirements Check List," or on other guidance received from the contracting office. When the guidance is not sufficiently detailed or clear, the contractor should take steps to obtain clarification.

Overclassification and misclassification can be expensive. In accordance with policy established by the Director for Classification Management, Office of the Assistant Secretary of Defense (Administration), contracting officers are responsible for assisting contractors in elaborating, interpreting and applying classification guidance. As a slogan, the Director for Classification Management suggests, "When in doubt—find out!"

DEFENSE INDUSTRY BULLETIN

Published by the Department of Defense
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The *Defense Industry Bulletin* is published monthly by the Business & Labor Division, Directorate for Community Relations, Office of the Assistant Secretary of Defense (Public Affairs). Use of funds for printing this publication was approved by the Director of the Bureau of the Budget.

The purpose of the *Bulletin* is to serve as a means of communication between the Department of Defense (DOD) and its authorized agencies and defense contractors and other business interests. It will serve as a guide to industry concerning official policies, programs and projects, and will seek to stimulate thought by members of the defense-industry team in solving the problems that may arise in fulfilling the requirements of the DOD.

Material in the *Bulletin* is selected to supply pertinent unclassified data of interest to the business community. Suggestions from industry representatives for topics to be covered in future issues should be forwarded to the Business & Labor Division.

The *Bulletin* is distributed each month to the agencies of Department of Defense, Army, Navy, and Air Force, and to representatives of industry. Request for copies should be addressed to the Business & Labor Division, OASD/PA, Room 2E813, The Pentagon, Washington, D.C. 20301, telephone, OXford 5-2709.

Changing Patterns in Management Theory

by

Maj. David I. Cleland, USAF
Maj. David C. Dellinger, USAF

The advancement of technology in all phases of industrial and military management since World War II has forced radical innovation in management theory and practice. In the Department of Defense the acquisition and development of weaponry has become a management problem of extraordinary proportions. Changing roles and missions of the military establishment and the increasing acceleration in the conception and development of weaponry have fostered the creation of unique and challenging approaches to the management process, approaches which cut across the neatly defined road maps of management theory. Similar and equally radical changes have occurred in the defense industry. There has been a tendency in the development of this approach for writers and practitioners to support their own ideas by downgrading or misrepresenting what others have contributed. The result has been some confusion regarding the management discipline.

This article will critically analyze the so-called "qualitative"—"quantitative" dichotomy that has evolved in management thought and theory in recent years. The analysis will be performed in the context of the management roles involved in the development, acquisition and employment of weaponry.[1] A brief resume of historical and contemporary management thought will serve as a conceptual foundation, even though such a foundation can only be offered at the risk of severe oversimplification of a complex subject.

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The Evolution of a Management Discipline.

Within this century there has developed in the United States a thriving economy, fostered by a dynamic revolution in technology and management thought. The professional manager has influenced all sectors of our society by providing skill in the management of human and non-human resources. Problems have confronted military and industrial leaders since antiquity, and various techniques of management have existed since the beginning of man's efforts to form organized groups for attaining mutual objectives. The systematic examination of management thought, and the development of a discipline devoted to codifying principles and developing a theory has been, for the most part, a product of the twentieth century. Management has long been recognized as an art, but only in the present century has scholarly interest developed in the designing of a conceptual framework for the teaching and practice of management.

The conceptualization of management theory in its modern meaning has a firm reference in the writings of industrialist Frederick W. Taylor early in the present century. Taylor's classic treatment about management as "knowing exactly what you want men to do, and then seeing that they do it in the best and cheapest way" introduced an era of scientific management at the shop level. Taylor was mainly concerned with the efficiency of workers and managers in actual production positions in the factory. This preoccupation at the operating level probably caused practitioners and scholars to neglect the problems of management at higher levels in the organizational structure. Koontz and O'Donnell at the Graduate School of Business Administration, University of California, Los Angeles, credit Henri Fayol, a French industrialist with being the father of modern management theory. Fayol's now classic book, "Administration Industrielle et Generale," published in 1916, was not translated into English until 1929; no English translation was published in the United States until around 1949.[2] Fayol's book presented a clear and perspective view of the management process. His examination and treatment of the organic functions of management are, in the main, still valid several decades later. Others have made contributions to the development of management principles and theory; yet the work of Taylor and Fayol remain as "classics" in the annals of management thought and theory.

The Meaning of Management.

Management is a distinct process or activity concerned with the achievement of objectives. It may be expressed in a number of different ways, viz., ". . . the task of creating the internal environment for organized effort to accomplish group goals. In coordinating group activity, the manager plans, organizes, staffs, directs and

[1] *Weaponry has an identifiable life cycle, viz., four phases: conceptual, definition, acquisition and operations. This life cycle begins with an idea or concept, progresses through definition and production and ends when the weapon or system is retired from the operational inventory of the Military Department.*

[2] *Koontz, Harold and O'Donnel, Cyril "Principles of Management," (McGraw-Hill Book Company, 1964), p. 17.*

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controls."[3] Ralph C. Davis of the Ohio State University defines management as ". . . the function of executive leadership anywhere."[4] The USAF defines management as the process of organizing and using resources to accomplish predetermined objectives.[5] Other definitions of management express fundamentally the same thought as reflected above. Throughout most definitions of management one finds certain universal elements, viz.,

- Management is a distinct process dealing with group activity.
- An objective is involved.
- The objectives are achieved through establishing salient relationships between human and non-human resources.
- Management necessitates that the manager relinquish the tendency to perform things for himself and accomplish objectives through working with others in the group situation.
- Decision making is pervasive in the management process.

Analysis of these elements indicates that considerable agreement exists concerning the functions and nature of the management process. This indicates a sense of maturing in the discipline with promise of the development of a scientifically based philosophy of management. The disquieting force in management theory today is the variety of approaches which are appearing from parochial areas. There are tendencies to formulate distinct approaches to management thereby neglecting the inter-disciplinary nature of the management process. The various approaches or "schools" of management theory include:[6]

The Traditional School. Founded by Henri Fayol, this approach highlights the management process of getting things done through people in organized groups. By analyzing the management process and identifying the underlying principles, a theory of management is formulated. Management is viewed as a universal activity by this group with the principles thereof holding true whether the group be a business, government, military, or other organization. This school deals principally with the organization aspect of the management process, although in later years the management functions were analyzed and dissected. Scholars in this field have some disagreement concerning the various organic functions of the manager; however, there is nearly complete agreement that planning, organizing and controlling are the primary functions of the manager. The traditional school centers around these ideas:

- Organizations function as an integrated entity on a vertical basis.
- A strong superior-subordinate relationship is required to preserve unity of command and to ensure unanimity of objective.
- Individual functional managers are parochial (and rightly so).
- Functional managers maintain lateral staff coordination to obtain integrated staff action.
- Organizational groups have a basic dichotomy, *viz., the line* and *the staff.*
- A scalar chain of authority relationships exist within the organization ranging from the ultimate authority to the lowest rank with the line of authority following every link in the chain.
- An employee should receive orders from one superior only.
- Work progresses among relatively autonomous functional units of an organization.

Human Behavior School. During the early days of the founding of the management discipline, primary emphasis centered around scientific management at the shop level. The employee was viewed as an instrument of employment to be utilized as efficiently as possible in production. The scientific selection and training of workmen, the establishment of optimum work quotas and the neglect of the human element of management caused a revisionist movement in the period following the 1929 depression. This movement revolutionized management thinking by focusing attention on the elements of job and work satisfaction as related to the human relations part of employment. As described by Keith Davis, Professor of Management, Arizona State University, ". . . human relations is the integration of people into a work situation that motivates them to work together productively, cooperatively and with economic, psychological and social satisfactions."[7] The human behavioral view of management places heavy emphasis on the interpersonal relations that exist in the management situation and is heavily oriented in the theories presented by the psychologists and sociologists. Perhaps more so than the traditional school, this approach is based on the thesis that managing is getting things done through people with the primary focus resting in the motivating function of management.

The Mathematical School (sometimes called "quantitative" management). This school includes those theorists who emphasize the use of mathematical models in managerial decision making. The best known group comprising this school include the operations researchers and management scientists who emphasize quantitative analysis in decision making. This group supports the idea that the essence of management is decision making, a process which can be expressed in terms of mathematical symbols and relationships. Mathematics then logically has a place in management through the requirement for objectivity and abstract reasoning. To label this school mathematical, however, is actually a misnomer as indicated in Professor Koontz's observation that:

> "There can be no doubt of the great usefulness of mathematical approaches to any field of inquiry. This type of approach forces upon the analyst the definition of a problem or problem area; conveniently logical methodology—developed by years of scientific application and abstraction—furnishes a powerful tool for solving or simplifying complex phenomena. But it is even harder to see mathematics as a truly separate school of management theory than it is to see it as a separate school in physics, chemistry, engineering, or medicine."[8]

Even though one could hardly argue that the mathematical approach constitutes a form of management, quantitative analysis properly occupies a strong position in the management process.

The Systems Approach. This most recent school opines that traditional management philosophy is pervaded with vertical flow of authority and responsibility relationships and emphasizes parts and segments of the organization. According to the systems school the traditional approach does not place sufficient import on the inter-relationships and integration of activities involved in the total array of components of the management system. The systems concept provides a *way of thinking* about the management process. It presents a theoretical framework for viewing the internal and external environmental factors as integrated into the whole. Explicit in this concept is the interdependency of decisions between all parts of components of the management problem. Such awareness of the system inter-

[3] *Ibid, p. 1.*

[4] *Davis, Ralph C., "The Fundamentals of Top Management," (Harper & Bros., Publishers, New York, 1951), p. 6.*

[5] *Air Force Manual 25–1, Oct. 15, 1964, p. 2.*

[6] *Several authors have described the schools of management theory. The article, "Making Sense of Management Theory," by Harold Koontz, Harvard Business Review (July–August 1962), is a primary source of material for the ensuing discussion of the "schools" of management. However, responsibility for the addition of the systems school in the present article belongs to the authors.*

[7] *Davis, Keith, "Human Relations at Work," (McGraw-Hill Book Co., Inc., 1962), p. 4.*

[8] *Harold Koontz, pp. 35–36.*

dependency discourages provincial decisions.

Each of the schools have their place in any management situation but vary in emphasis depending upon the particular environmental conditions that are encountered. One of the most provocative areas of management is that of developing a modern weapon system. In this environment is found the project manager* (or systems manager), a manager that is confronted with a unique set of circumstances and forces that channel his thought and behavior into somewhat singular patterns of response.

Today's project manager is facing an interlaced sequential managerial activity encompassing broad spectrums of authority and responsibility. The complexity of management relationships cause vast resources to be exhausted before retrenchment or redirection can be effected.

Change has become a normal way of life and the increase in the rate of change has vastly complicated the manager's decision problems. The number of alternatives which are open for consideration in the selection of weaponry have increased at a phenomenal rate and the consequences of error have become profoundly serious.

Experience alone has proven inadequate for coping with these rapid changes; managers have been forced to develop better methods for making and executing decisions. The development of electronic computers has made it possible to rapidly process and manipulate large quantities of data and has made it feasible to conduct quantitative analysis heretofore impractical. The introduction of quantitative analysis into management processes has manifestly changed the way we think about the management task. Managers in industry and Government are beginning to recognize the tremendous potential of the computer and the quantitative tools of the operations research as aids in the decision process.

There is some evidence to indicate that a cleavage has developed between those who belong to the earlier mentioned Mathematical School and the other schools of management, primarily the Traditional School. The terms qualitative and quantitative managements have been used to indicate these two schools. It is the thesis of this article that a view of management which does not combine the contributions of these two schools in the management process is erroneous. One does not have the simple alternative of being either a qualitative manager or a quantitative manager. To formulate a philosophy of management on this basis can easily lead to the unfortunate impression that the question is one of utilizing either quantitative analysis or qualitative analysis in the management function. Such is not the case. The difference which should be emphasized is neither one of methodology nor point of view, but rather the particular aspects of the managerial problems and the degree of analysis essential to the management task.

The manager's job can be viewed as a two-step process; (1) deciding what should be done and (2) assuring that actions are taken to effect the decision. For convenience, these steps can be designated *the decision process* and *the execution process*, respectively. It is quite clear that the manager must assume responsibility for both these processes. To perform only one would accomplish something less than the total management job required. The portion of the total management job comprising each of these processes varies with the job. In large highly centralized organizations, lower level managers are not given authority to make major decisions; their jobs are primarily concerned with execution. Their decisions are likely to be such that little analysis is required; experience and policy direction provide an adequate guide to decision making. Conversely, higher level executives in large organizations depend upon an administrative apparatus for the execution process and concentrate their attention on long-range planning and on critical and comprehensive decisions. Experience itself is often an inadequate basis for decision making on the level; the process must be supplemented with analysis. Perhaps a better way of saying it is that experience and judgment must be integrated into an analytical framework to complement the decision-making process.

The Mathematical School or quantitative managers concern themselves with analysis for decision making almost entirely. They emphasize the use of a formal analysis and the use of computer technology, mathematical models and related techniques in the decision process. Members of the traditional or qualitative school address themselves to the entire management problem, *i.e.*, both the decision process and the execution process, but emphasize the execution process, possibly to the neglect of the decision process.

Decision making has been an integral element of management literature appearing in the first half of this century; increased momentum in decision theory in the last 20 years has centered around the emergence of adaptable and sophisticated tools of mathematics and statistics. The most vital decisions are nonrecurring; Peter Drucker has explained these vital decisions in this manner:

> "The important decisions, the decisions that really matter, are strategic. They involve either finding out what the situation is, or changing it, either finding out what the resources are or what they should be. These are the specifically managerial decisions. Anyone who is a manager has to make such strategic decisions, and the higher his level in the management hierarchy, the more of them he must make."[9]

Strategic decisions are unique as compared to routine decisions through the involvement of forces of (1) high degree of risk and uncertainty; (2) critical elements of futurity; (3) heavy committment of human and non-human resources; and (4) manifestly affecting the organization's competitive position.

Traditional theory has, in the main, approached decision making from the basis of five distinct phases:

- Defining the problem.
- Analyzing the problem.
- Developing alternate solutions.
- Deciding on the best solution.
- Converting the decision into effective action.

Each phase of the foregoing has several steps. What traditional theory has failed to do is provide a rigorous definition of framework for analysis, to establish criteria to assess unknowns and to require the logic and methodology of mathematics.

A philosophy of management which considers quantitative and qualitative as two separate and distinct forms of management not only is erroneous and misleading but indicates a serious misunderstanding of the management process. To say that the *quantitative manager* considers only the quantitative aspects of management problems and that the *qualitative manager* evaluates just qualitative aspects of management is illogical. Management problems just don't come with their salient issues neatly divided in this manner; any aspect can be treated (perhaps inadequately) from either quantitative or qualitative methodology. The very essence of the managerial decision process is that of determining how to treat the various aspects of the problem and what interrelations exist between them. *If there is a meaningful issue between these schools, it is the question of the depth of analysis and methodology required for adequate decision making. Traditional management*

* *Note: The project manager is an extraordinary individual in the Defense industry establishment; he may simply be defined as that individual who is appointed to accomplish the task of integrating functional and extra-organizational efforts directed toward the development and acquisition of weaponry. For a discussion of the role and mission see "The Project Manager—Manager Extraordinary,"* Defense Industry Bulletin *(May 1965).*

[9] *Drucker, Peter F., "Practice of Management," (Harper & Bros., Publishers, New York, 1954).*

theory has not emphasized analysis to the depth which can be realized through the use of mathematical logic. While traditional theory does advocate analysis, it is an analysis which is based largely on experience gained in similar situations.

This is quite different from the view of analysis which a *quantitative* manager would take. As will be discussed subsequently, he would advocate a tailored analytical structure for each decision and the use of any of a number of techniques as applicable to the particular problem. Traditional management theory has its roots in a time period when the rate of change in the environment was relatively low compared to contemporary and recent past times, when it was not practical to emphasize analysis in depth for decision making. The theory of analysis was not developed to the extent that non-mathematicians could apply it, nor were computers available to economically process the immense amount of data sometimes required to make analysis in depth feasible. Moreover, the decision problems did not generally require the depth of analysis. Experience alone did provide an adequate basis for more discussion. This is not the case today and the industrial-Defense manager must develop a philosophy to keep pace with the challenge of contemporary management problems.

In the following sections, traditional management theory with its recent innovations is discussed to illustrate the emphasis on the execution process and the views of the mathematical school are portrayed to illustrate its emphasis on the decision-making process. Finally, the two approaches are combined to indicate the interdependency of both approaches in the total management job.

Looking at the traditional framework of management, one finds that what the manager does is fundamental and universal in its application regardless of the type of organization involved be it military, ecclesiastical, industrial, or even illegal. All managers, regardless of their level in an organization, perform certain basic functions directed toward the accomplishment of a predetermined goal or objective. Management has both the elements of an art and a science. As an art it requires skill in performance acquired through experience. As a science, management is furthered by knowledge which has been systematized and formulated through the discovery of general truths or principles. Science and art in the management discipline are complementary; they are not mutually exclusive in the management process. One may, however, have a sound theoretical knowledge of management yet fail in performance as a manager because of lack of proficiency in the *art* of the discipline, particularly when the management process requires close and continuing contact with people.

Management is a distinct field of knowledge and skills apart from technical skills such as engineering, accounting, production, procurement and the many other skills found in complex organizations. Today's manager should be vitally concerned with continuing the development of an underlying theory or philosophy of management in order to provide a broad framework for the making and execution of decision in the complex military-industrial environment. The cornerstone of traditional management theory is principles; these fundamental maxims explain certain phenomena and constitute the framework around which a theory is built. Some of these principles are easily recognized through the observation of management experience, while others are still in the state of an hypothesis, requiring verification and codification.

Occasionally one finds examples where a principle is disregarded in practice. For example, the hasty critic may point to dual subordination in an organization and come to the erroneous conclusion that there is no substance or validity in the principle of unity of command.[10]

Functions of the Manager.

Management was described earlier as a distinct skill apart from the technical skills involved in an organization. It is composed of identifiable functions or homogenous activities that are integral to the management process. While some disagreement exists among current academicians and practitioners, abundant evidence reflects that a manager accomplishes the *planning*, *organizing* and *controlling* of human and non-human resources. Planning, the most abstract of these functions, involves the determination in advance of what should be done, by whom and when the performance should be accomplished. Organization has to do with the procurement of human and non-human factors, the grouping and alignment of personnel and equipment and the delegation of authority and responsibility within the organizational structure.

Study of the organizing process includes recognition of the more complex system of informal relationships which exist in any group activity. Informal organization is that network of personal and inter-social relationships existing along with the formal organizational structure but not required or identified in the unit's documentation. The informal organization emphasizes people and the roles they have as granted by their peers, whereas formal organization emphasizes functions, positions and specific grants of authority and responsibility.[11]

Controlling has to do with making events conform to plans, i.e., coordinating the action of all parts of the organization according to the plan which has been established for the attainment of the objective. The manager performs all these functions somewhat continuously. They are performed regardless of the organizational level but with different emphasis being placed on each function depending on the level within the organization. The operational manager, for example, who is charged with responsibility for the accomplishment of a specific mission, is more concerned with the control function as he approaches the point of performance of the mission itself. A staff official, on the other hand, who is charged with the development of the overall plan, is more involved with the planning function than with organizing or controlling.

Authority and Responsibility Patterns.

A discussion of management theory is not complete without an examination of the responsibility and authority patterns involved in the management relationship. Authority and responsibility constitute the legal framework of management. Authority is defined as the right derived from some legitimate source to direct the efforts of others in a common endeavor. It is the power to act. Ultimate formal authority as derived in the military establishment flows from the Constitution through various hierarchial levels to the local military commander. This is *legal authority* which attaches to an organizational position and provides an important source of power. Such authority does not, however, give a superior the right to make someone do something in an absolute sense. It does provide important penalties and rewards in the form of promotions, job assignments, etc., which have the effect of a real meaningful power over the subordinates.

In the long range effort, however, a manager must have that authority which comes from the acceptance and respect which his subordinates have for him. Only formal authority can be delegated; one cannot delegate influence. All that can be done is to assure that the manager has those environmental conditions which en-

[10] *Derivation of the unity of command principle, i.e., an employee should receive orders from only one superior, is credited to Henry Fayol. Doubtlessly, this principle can easily be upheld in a small organizational arrangement where the management process operates solely through superior/subordinate relationships. In today's large organizations, particularly in the acquisition and employment of weaponry, the management of a project or a task force cuts across many different organizations, thus casting some doubt about the universality of this principle.*

[11] *See "Human Relations at Work," by Keith Davis (McGraw-Hill Book Co., New York, 1962) for an excellent discussion on the phenomenon of the informal organization.*

(Continued on Page 17)

The Navy's Apollo Mission

by
Cdr. R. C. Doxey, USN
Instrumentation Ship Project Office
Bureau of Ships

Within this decade three Americans will embark on man's boldest venture and journey to the moon. After brief exploration of the surface by two of the astronauts, the lunar pioneers will return to earth. This major United States goal is Project Apollo.

A world-wide network of electronic facilities to support Apollo is being constructed. With approximately three quarters of the earth's surface covered with water, certain stations of the Apollo network must be installed in floating platforms or ships for operation at sea.

The Instrumentation Ships Project is the focal point of Navy responsibility for construction, conversion and modification of the range instrumentation ships which support the Defense Department and the National Aeronautics and Space Administration world-wide tracking requirements. The Instrumentation Ships Project Office (ISPO) was established as a Designated Project on January 24, 1964, by the Chief of Naval Material and is one of the nine projects whose managers report directly to the Chief of Naval Material.

The charter provided that ISPO be physically located in and administratively supported by the Bureau of Ships (BUSHIPS) and, except for the NASA and Air Force deputies and their staffs, ISPO billets be manned by BUSHIPS personnel. As defined by the project charter, ISPO's mission is "to provide the intensified techniques of project management in the prosecution of the Instrumentation Ships Project" and project scope is "reconditioning, modifying, equipping and checking out all DOD General Purpose Instrumentation Ships in support of the DOD and NASA tracking requirements world-wide."

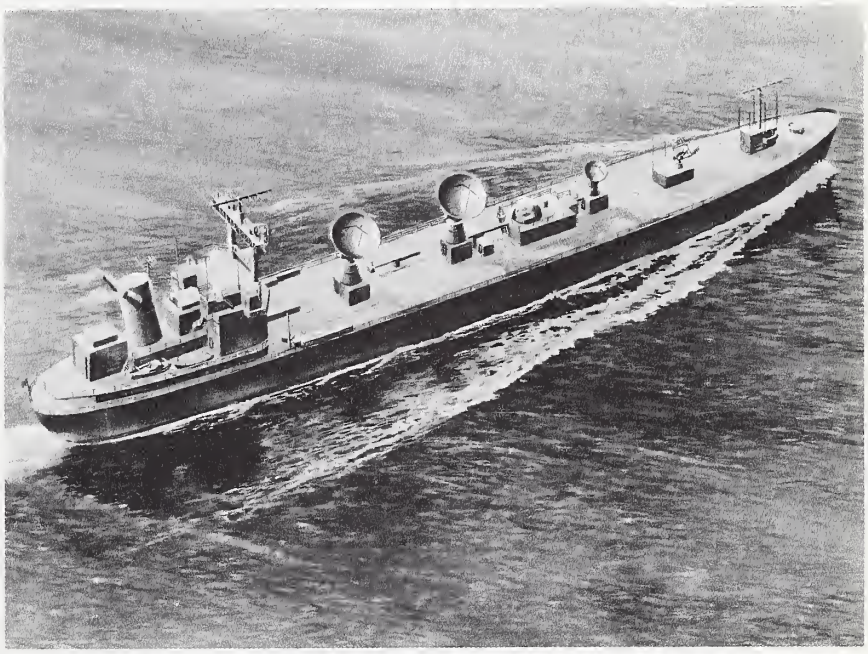
Range instrumentation ships are the special category of Military Sea Transportation Service (MSTS) special project ships employed to supplement land-based facilities in support of the national ranges. The ships are manned by MSTS civil service or MSTS contract civilian marine crews and are sailed under the operational control of the range commander, who provides the technical crews. These public vessels are non commissioned United States naval ships (vice United States ships) and bear T–AGM hull designators.

Apollo ships and ARIS ships are terms often used to describe two special categories of range instrumentation ships. The Apollo ships are the five ships being specially configured for support of NASA's project Apollo and will also have the capability to support DOD space missions. ARIS ships are the two ships converted under the Air Force's *A*dvanced *R*ange *I*nstrumentation *S*hip program. The terms ocean range vessel (ORV), range vessel, range ship and tracking ship are also used to identify range instrumentation ships.

There are 20 range instrumentation ships currently in the national inventory. Nineteen ships support (or will support after completion of conversion work) the operations of the Air Force's Eastern Test Range headquartered at Patrick AFB, Fla., and the Air Force Western Test Range at Vandenberg AFB, Calif. The remaining ship, USNS Wheeling (T–AGM–8), supports operations of the Navy's Pacific Missile Range at Point Mugu, Calif. All 20 range instrumentation ships were (or are being) converted from World War II merchant type ships in the Maritime Administration's National Defense Reserve Fleets. Generally speaking, the details of conversion work conform to commercial marine rather than military practice. Since Coast Guard certification is normally required, the requirements of the Coast Guard and the American Bureau of Shipping are applicable during conversion or modification work.

Much of ISPO's efforts thus far have been concentrated on the major task of providing the five specially configured Apollo instrumentation ships. These instrumentation ships with their unified S-band systems and extensive tracking, telementry, command control and communication facilities are required to supplement shore instrumentation complexes during the insertion, injection and reentry phases of not only manned lunar flights but the series of preparatory unmanned launches as well. This project office coordinated preparation of drawings and detail specifications to fulfill NASA-Air Force outline requirements for the Apollo support ships. Instrumentation design was performed by BUSHIPS engineers working with engineers of the Pacific Missile Range. Other significant contributions to the project were made by engineers of the Air Force's Eastern Test Range and NASA's Goddard Space Flight Center. Over six months of intra-governmental effort by the project office and BUSHIPS resulted in meeting early target dates for completion of contract specifications and plans in this top priority national program.

Outline requirements called for highly sophisticated instrumentation complexes installed in merchantmen hulls of World War II vintage. Therefore, a contracting approach unique in ship conversion procurement was employed. First, for the three insertion/injection ships and later for the two reentry ships, methods and management proposals were solicited from the electronics industry for proposed techniques, personnel and facilities to be used with a shipyard subcontractor in accomplishing the work. After highly competitive bidding by those electronic firms establishing eligibil-



Artist's concept of a range instrumentation ship to be used to support NASA world-wide tracking requirements.

ity, fixed price contracts were awarded by BUSHIPS in September 1964 for the insertion/injection ships and in March 1965 for the reentry ships.

Thus, three "Mission Class" tankers from the Maritime Administration reserve fleets are being converted by General Dynamics/Electronics at the General Dynamics/Electric Boat shipyard in Quincy, Mass. These conversions include jumboization of the hulls, reactivation and repair of machinery plants and installation of technicians' quarters and instrumentation facilities in the new mid-bodies along with three lounges, a physical training room, workshops, a hobby shop and a library. There also are storage facilities for repair parts and equipment, conference rooms, briefing rooms, offices, photographic laboratories and all the normal hotel facilities essential to the mission.

Originally named Mission San Fernando, Mission San Juan and Mission De Pala, the ships will be renamed USNS Vanguard, USNS Redstone and USNS Mercury, respectively, after United States space programs, and bear T–AGM–19, T–AGM–20 and T–AGM–21 hull numbers.

The first ship, Vanguard, was floated from its building dock on September 9, 1965. It should have trials by the Navy's Board of Inspection and Survey in February 1966 and complete instrumentation tests by mid-June. Redstone and Mercury will follow at three-month intervals.

Two existing range instrumentation ships, USNS Watertown (T–AGM–6) and USNS Huntsville (T–AGM–7), were converted originally from Victory ships and are being modified to reentry ships by Ling-Temco-Vought's Range Systems Division at Avondale Shipyard in New Orleans, La.

Instrumentation installations and mission support capabilities of the 15 other range instrumentation ships vary considerably among the ships. When modification of a ship is required to meet operational needs, the project office coordinates translation of the outline requirements provided by the range into the detail specifications, contract plans and contract guidance plans needed for a competitive, fixed price procurement. Compared to the five Apollo instrumentation ships, work scope is much less on this type of project, but all elements of the pre-procurement cycle are present.

While the focus of liaison and Navy endeavor relating to a specific ship project is ISPO's project engineer, under the project manager, the project office has neither the manpower nor the versatility to produce the design package, perform the contracting function, monitor contractor performance, or accomplish the profusion of other tasks required for successful ship delivery. The wide experience in shipbuilding and diverse talents of the existing functional organization of BUSHIPS and its field activities are utilized, each element contributing its part to the whole in accordance with traditional shipbuilding practice. In addition, important contributions to the design package are made by instrumentation engineers of the Pacific Missile Range, a field activity of the Bureau of Naval Weapons.

Employment of existing elements of the Naval Material Support Establishment (NMSE) to fulfill the mission of the Instrumentation Ships Project was specified in the project charter. The spirited cooperation, technical excellence and prompt response to ISPO tasks by personnel of these diverse organizations are responsible for the success of this Chief of Naval Material Designated Project.

Drawing of the Range Instrumentation Ship USNS Watertown. Originally converted from a Victory ship, the new vessel is being modified to support the U.S.'s Apollo mission.

Main Battle Tank Contract Awarded

The U.S. Army signed a $43,728,000 contract with General Motors Corp., of Indianapolis, Ind., Dec. 15, for the completion of development work on the United States/Federal Republic of Germany Main Battle Tank Program (MBT).

Negotiations leading to the current contract were based on design, configuration and major component selection decisions announced last June by the defense heads of both countries.

This successful contracting effort guarantees unniterrupted progress for the new Main Battle Tank and marks a major milestone in the life of this unique, international development effort.

The contract provides for $11.7 million of the award to go to two subcontractors: Continental Aviation & Engineering Corp., Detroit, Mich., for a high horse power engine; and National Waterlift Corp., Kalamazoo, Mich., for a new type suspension system.

General Motors was selected as the American contractor in July 1964 and, to date, has completed its contribution to the initial phases of the MBT program. The current contract covers Phase III, which terminates with the fabrication of pilot models as provided under the basic agreement between the United States and the Federal Republic of Germany signed Aug. 1, 1963.

ICAF Renames Correspondence Course

The Industrial College of the Armed Forces correspondence course has a new name—"National Security Management." Effective Dec. 1, 1965, the old title of "The Economics of National Security" was dropped and the new one adopted.

The new title is considered more descriptive of the material presented and reflects more vividly the intent of the course, which is to create a better understanding of the managerial aspects of national security.

The Industrial College is also undertaking a major revision of the course to bring it in line with resident course revisions. This will proceed on a continuing basis over several years and will result in the introducton of a number of new texts and revision of the remainder.

Change in the name of the course or planned revisions will not alter the present system of awarding retention and retirement points to reservists.

Inquiries about the correspondence course should be addressed to the Commandant, Industrial College of the Armed Forces, ATTN: Correspondence School, Fort Lesley J. McNair, Washington, D.C.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Dr. James M. Bridges, Special Asst. for Command and Control to the Dir., Defense Research & Engineering, retired on Dec. 30, 1965.

Jack L. Stempler has been appointed Asst. to the Secretary of Defense (Legislative Affairs). He replaces **David E. McGiffert,** who was sworn in as Under Secretary of the Army on Nov. 30.

The Advanced Research Projects Agency has selected **Maj Gen. Charles J. Timmes,** USA, to succeed retiring **Maj. Gen. R. H. Wienecke, USA,** as Dir., Remote Area Conflict (Project AGILE).

RAdm. Ira F. Haddock, SC, USN, former Asst. Chief of the Bureau of Supply & Accounts for Supply Management, Department of the Navy, has become Commander, Defense Construction Supply Center, Columbus, Ohio. He succeeds **Brig. Gen. Robert H. Herman, USAF,** who has retired.

DEPARTMENT OF THE ARMY

Maj. Gen. Donald V. Bennett succeeds **Lt. Gen. James B. Lampert** as Superintendent of the U.S. Military Academy at West Point.

Maj. Gen. Alexander D. Surles, Jr., has relieved **Maj. Gen. Andrew J. Boyle** as Commanding General, Armor Center, Fort Knox, Ky.

Maj. Gen. Frank A. Osmanski has been assigned as Deputy Commanding General, Army Supply and Maintenance Command, and Chief, Army Materiel Command Operational Readiness Office.

The U.S. Army Mobility Command has appointed Dr. **Ernest N. Petrick** as chief scientist at MOCOM Headquarters, Warren, Mich.

Brig. Gen. Elias C. Townsend succeeds **Maj. Gen. Charles F. Leonard, Jr.,** as Commanding General, U.S. Army Intelligence Command, Fort Holabird, Md.

Brig. Gen. William B. Latta has been assigned as Commanding General, Army Electronics Command, Fort Monmouth, N.J. His previous assignment was as Deputy Chief of Staff for Communications and Electronics, North American Air Defense Command and Continental Air Defense Command.

Brig. Gen. Walter B. Bess is new Commanding General for the vast European network of signal facilities of the Army's Strategic Communications Command.

Col. Wyatte G. Trainer became Comptroller in the Office of the Chief of Engineers on Jan. 3. He succeeds **Col. Cecil H. Fuller,** who has retired. **Col. Remi O. Renier** has been assigned as Dep. Div. Engineer, New England Div., U. S. Army Corps of Engineers, Waltham, Mass. to succeed **Col. Edward J. Ribbs,** who plans to retire early in 1966.

Col. Lawrence R. Klar, former Chief of the Objectives Div., Defense Communications Agency, has been named new head of the Equipment Applications Directorate of the Army's Strategic Communications Command. He relieves **Col. J. G. Moak,** who is the command's new Chief of Staff.

Col. William J. Durrenberger, Commanding Officer, Springfield Armory since July 1963, has assumed command of the Army Tank Automotive Center, Warren, Mich. He succeeded **Col. Henry Davidson, Jr.,** who has retired.

Col. Morton M. Jones, Jr., has joined the Army Mobility Command, Warren, Mich., as Project Manager for General Purpose Vehicles.

Command of the Army Research Office-Durham, N.C., has been assumed by **Col. John C. Raaen, Jr.**

Assignment of **Lt. Col. Leslie G. Callahan, Jr.,** as the first director of the Avionics Laboratory has been announced by Army Electronics Command, Fort Monmouth, N.J.

DEPARTMENT OF THE NAVY

RAdm. John J. Hyland has been assigned as Commander of the U.S. Seventh Fleet in the Far East. The new Seventh Fleet Commander, who will be promoted to the rank of vice admiral, previously served as Director of the Strategic Plans Div., Office of the Chief of Naval Operations, Washington, D.C.

RAdm Allan F. Fleming has been selected as Assistant Director of the Strategic Plans Div., Office of the Chief of Naval Operations. He was Commander Carrier Division Four prior to his new assignment.

DEPARTMENT OF THE AIR FORCE

Maj. Gen. Osmand J. Ritland, Deputy Commander, Manned Space Flight, Air Force Systems Command, Andrews AFB, Washington, D.C., has retired from the Air Force.

Maj. Gen. Harold E. Humfeld has been reassigned as Commander of the Strategic Aerospace Div., SAC, Vandenberg AFB, Calif.

Brig. Gen. Thomas H. Crouch, has relieved **Maj. Gen. Theodore C. Bedwell, Jr.,** as Commander, Aerospace Medical Div., Air Force Systems Command, Brooks AFB, Tex.

Tung-Sheng Liu has been named Systems Engineering Director of the C–5A Systems Program Office.

Col. Currie S. Downie has been assigned as Director of Research Programs, Office of Aerospace Research.

Col. Richard E. Potter is the new Director of Command, Control and Communications, Headquarters, U.S. Air Force.

The Air Force System's Command's new liaison office in Saigon will be headed by **Col. John V. Patterson.** The new office was established by the command's Aeronautical Systems Div.

Col. Bert M. Smiley has succeeded **Brig. Gen. William R. Yancey** as Deputy for Reconnaissance at the Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson AFB, Ohio.

Small Business Firm Wins Heater Contract

Small business concern managers, who sometimes feel that competing for Government contracts is solely for large industry, should take heart from the example being set by Keysor of Byron, Inc., a small business located in Rockford, Ill.

The company was successful in winning a $1,689,270 multi-year (3 years) Army contract to produce 16,500 −25° F. heater kits for use in the Army's M151 ¼-ton trucks.

The contract, which was set aside for small business concerns, was awarded to Keysor of Byron as a result of competitive bidding.

It was the first time that a two-step, formally advertised, high dollar volume, major secondary item was ever awarded by the Army on a multi-year basis.

Delivery of the heater kits will conclude in May 1968.

The contract was awarded by the Office of the Project Manager for General Purpose Vehicles, Army Mobility Command, Warren, Mich.

Sparrow Missile Tests Conducted by USN-USAF

A joint Air Force-Navy project is under way at the Air Force Missile Development Center, Holloman AFB, N.M., to assess the performance of the Sparrow missile when used with an Air Force F–4C or a Navy F–4B.

The F–4C is the McDonnell-built multipurpose two-man fighter aircraft able to fly at Mach 2 speeds and better. The F–4B is the Navy version of this aircraft.

The AIM–7D air interceptor missile Sparrow is a single-stage solid-fuel air-to-air missile. It has a slim 12-foot long by eight-inch-diameter shape, and a wingspan of 40 inches.

Other flight tests in the overall joint program are being conducted at the Navy's Point Mugu station in California and at Eglin AFB, Fla. Tests are being conducted at varying altitudes and speeds to investigate different flight or compatibility problems.

CALENDAR OF EVENTS

Feb. 10–11: Armed Forces Communications & Electronics Assn. Symposium, Sheraton-Park Hotel, Washington, D. C.
Feb. 13–16: Radiation Research Society Meeting, Coronado, Calif.
Feb. 17–19: Institute of Management Sciences Meeting, Dallas, Tex.
Feb. 28–March 2: 8th Joint National Security Industrial Assn. Industry-Military-Government Packaging & Materials Handling Symposium, Washington, D. C.
March 3–4: DOD-National Security Industrial Assn. Advanced Planning Briefings for Industry, Boston, Mass.
March 9–10: DOD-National Security Industrial Assn. Advanced Planning Briefings for Industry, Atlanta, Ga.
March 16–17: DOD-National Security Industrial Assn. Advanced Planning Briefings for Industry, St. Louis, Mo.
March 21–24: Institute of Electrical & Electronic Engineers Exposition, New York City.
March 22–31: American Chemical Society Meeting, Pittsburgh, Pa.
March 23–26: Air Force Assn. Convention, Dallas, Tex.
March 27–April 2: American Society of Photogrammetry Meeting, Washington, D. C.
April 5–6: Armed Forces Communications Electronics Assn.-U. S. Army Electronics Command Symposium, Fort Monmouth, N. J.
April 11–15: Institute of Environmental Sciences Meeting, San Diego.
April 12–13: DOD-National Security Industrial Assn. Advanced Planning Briefings for Industry, San Franciso, Calif.
April 18–21: Aerospace Medical Assn. Meeting, Las Vegas, Nev.
April 18–22: American Geophysical Union Meeting, Washington, D. C.
April 18–22: American Society of Tool and Manufacturing Engineers Meeting, San Francisco, Calif.
April 24–28: American Society of Mechanical Engineers Meeting, Kansas City, Mo.
April 27–28: DOD-National Security Industrial Assn. Advanced Planning Briefings for Industry, Washington, D. C.

Navy Bureau of Yards & Docks Manages DOD Construction in S.E. Asia

As construction agent in Southeast Asia for the Department of Defense, the Navy's Bureau of Yards and Docks has been responsible for the completion of more than $150 million in military construction in South Vietnam and, on completion of work now assigned, will have added another $150 million in construction projects.

Major work is now under way at 14 principal locations from Da Nang and Phu Bai in the North to Soc Trang in the delta area, with projects of lesser size in progress at scores of other sites.

The master plan for Da Nang including the adjoining East Da Nang complex calls for a 10,000-foot concrete and asphalt runway at the main air base which is already operational, a POL tank farm with an off-shore unloading fuel line, perimeter security locations, two deep draft piers and a storage area.

To relieve congestion at the main air base, a parallel 10,000-foot runway is under construction. A $5 million aircraft control and warning facility on an adjacent mountain top has been completed. Support facilities constructed or under construction at Da Nang include cantonments to house military personnel, munition and fuel storage areas and warehousing.

To further relieve congestion at the main Da Nang airfield an additional air facility, chiefly for helicopters, has been constructed at Da Nang East which is separated from the main air base by the Tourane River. Called Marble Mountain Air Facility, it has a 2,000-foot pierced steel plank runway and a 135,000-square-yard pierced steel plank parking apron. Construction of a 400-bed advanced base hospital is also in progress.

To alleviate logistic supply problems, Cam Ranh Bay is being developed into a major advanced deep water port. A 600-foot concrete pier built there can accommodate two ships at a time.

A few miles north of the port, the Cam Ranh airfield is being rushed to completion. Here, a 10,000-foot AM–2 aluminum mat runway was completed and operational in 70 days. A parallel taxiway has been completed and a parking apron is nearing completion. Support facilities adjacent to the parking apron and a cantonment for Air Force personnel have also been finished.

More than 24,000 workers are employed in South Vietnam to complete these projects and over $26 million worth of construction equipment is being used. Construction material is flowing out of West Coast ports in the United States at a rate measured in millions of dollars worth each week.

GSA Authorizes Sale of Security Cabinets to Canada

Canada's Department of Defence has been given permission by the General Services Administration's U.S. Federal Supply Service to purchase approved Class III non-insulated security filing cabinets for use within the Dominion of Canada. The request for this authorization came from the Director of Industrial Security, Department of Defence Production, Government of Canada, Ottawa, Canada.

Canadian contractors, including Canadian governmental agencies, may be authorized by Federal agencies to utilize our Federal Supply Schedules pursuant to the provisions of Subpart 1–5.9, Federal Procurement Regulations, and Section 101–26.407, Federal Property Management Regulations.

In addition, the Federal Supply Service will permit its Federal Supply Schedule contractors to sell equipment directly to the Canadian government or any contractor authorized by the Canadian government to purchase such equipment. The grant of such permission will accommodate the government of Canada in cases in which it or its contractors are not eligible to procure cabinets under the terms of the above cited regulations.

MATS Now MAC

The Military Air Transport Service (MATS) was officially redesignated as Military Airlift Command (MAC) on Jan. 1, 1966.

Representative L. Mendel Rivers, D.–S.C., who introduced the bill calling for a change in name, said it is more descriptive of the true function performed by MAC and provides recognition of its vital missions.

Mr. Rivers added that it was somewhat lacking in "dignity" for this important element of U.S. military capability to be designated a "service."

Although the command has a new name, its mission remains the same—airlift, air weather, air rescue, photography and charting.

Under the change, the name of the Air Photographic and Charting Service (APCS) became the Aerospace Audio Visual Service (AAVS). The Air Rescue is now known as the Aerospace Rescue and Recovery Service (ARRS).

The Eastern and Western Air Transport Forces (EASTAF and WESTAF) were also redesignated. EASTAF became the 21st Air Force and WESTAF the 22nd Air Force.

This is GEEIA

by

Brig. Gen. Stephen D. McElroy, USAF

The new North American Air Defense Command Operations Center in Cheyenne Mountain near Colorado Springs, Colo., became operational on January 1 of this year. This command and control complex is deep within the heart of the legendary 9,200-foot peak towering more than half a mile over Colorado Springs and is fast becoming honeycombed with a network of passages filled with three story buildings. Inside are communications facilities engineered and installed by the Air Force Logistics Command's Ground Electronics Engineering Installation Agency (GEEIA).

The Cheyenne Mountain job is only one of the many simultaneous engineering, installation and maintenance tasks carried out by GEEIA. But this wasn't always the case.

Prior to 1958 there were 24 Air Force activities in some seven commands engaged in the business of engineering and installing ground Communications-Electronics (C–E) facilities. Thus, there existed cumbersome coordination channels, competition for limited resources, a dissipation of resources and a non-standardization of end products. All this contributed to a very delinquent Air Force ground C–E program.

Out of these circumstances, GEEIA was born on June 15, 1958. This centralized the vast majority of the Air Force ground C–E engineering and installation requirements under one command, the Air Force Logistics Command (AFLC).

GEEIA started with the small cadre of eight officers, one airman and 20 civilians at Griffiss AFB, N.Y., as part of the Rome Air Materiel Area (ROAMA). Today, GEEIA's far flung organizational elements are found in all corners of the free world. Personnel are working in 45 states and 29 foreign countries, from Cape Kennedy to Saigon and Athens to Anchorage. GEEIA troops can be found at more than 400 different locations on any given day.

In 1964, the mobile depot activity units, which performed on-site depot level maintenance on ground C–E gear, were assigned to and merged into the GEEIA organization.

AFLC announced on Jan. 1, 1965, that GEEIA was no longer a part of ROAMA and was to report directly to Headquarters, AFLC. GEEIA's mission is covered by AFLC Regulation 23–17. It encompasses these responsibilities:

- Develop and publish technical standards.
- Provide technical assistance directly to Air Force commands in developing C–E requirements in what is known as a C–E Implementation Plan or CEIP.
- Prepare base wire and telephone development schedules.
- Engineer, install and provide on-site depot level maintenance on ground C–E facilities.
- Control and manage C–E materiel resources needed to accomplish the installation and depot level maintenance on C–E facilities.
- Accomplish systems implementation testing and acceptance of facilities.
- Accomplish interference radiation and hazard reduction.
- Train and develop a reserve force for wartime or national emergency.
- Participate, as required, in the Military Assistance Program (MAP).
- Provide on-site mobile depot level maintenance for ground C–E facilities.

GEEIA prepares the engineering required for installation and then carries out the installation of ground C–E facilities such as communications centers, long range radars, Nav-Aids, command and control systems, to name a few. The customer (the major air commands) initiates the requirement. GEEIA insures that the material is available to do the job, that it arrives on site by the required installation date, that it is completely installed, tested and then turned over to the customer.

However, GEEIA's concern does not end here. It continues with the responsibility for on-site depot level maintenance and the modification of the equipment which it installed. Additionally, when the equipment becomes obsolete and is no longer required, GEEIA knocks it down. Thus, its job in the C–E business is more than a "cradle-grave" operation. It is a "conception to the grave" responsibility.

Brig. Gen. Stephen D. McElroy, USAF, is Commander, Ground Electronics Engineering-Installation Agency (GEEIA), which is headquartered at Griffis AFB, N.Y. GEEIA is the Air Force's single manager for the engineering, installation and on-site depot level maintenance of its ground communications-electronics systems and facilities.

GEEIA has 427 officers, 4,200 airmen, 3,000 civilians, including 1,400 civil service, 1,100 wage board and 300 foreign nationals. Under a USAF-directed program it is converting its 758 Contract Technical Services personnel to civil service and military members.

This force is further backed by a first-line, fully-qualified installation-maintenance capability present in the Air National Guard (ANG).

Approximately 3,000 highly skilled troops in 17 ANG squadrons are located in the United States. These ANG officers and airmen, with approximately 17 to 20 years experience each in the C–E installations business working for Bell Telephone, local power companies, etc., represent a valuable capability as a C–E recovery force in the event of national emergency or disaster. In their training periods, these ANG troops are accomplishing useful and valuable work for the Air Force. GEEIA workloaded these squadrons last year with more than 150,000 manhours.

At the work sites, the job is in the hands of an installation team. This team will range in size from two to 15 airmen. The team chief is usually a noncommissioned officer. In some cases it has been necessary to place the responsibility in the hands of an airman first class.

Since GEEIA has a bigger workload than its organic capability, it must go to contract for some of its workload. For example, in the past year GEEIA took on 4,500 jobs—3,500 by GEEIA troops and 1,000 by contract. Some of the recent accomplishments of these men have created high level interest and borne such names as Star Sapphire, Back Porch, Wind Drift and the previously mentioned Cheyenne Mountain complex.

As a means of improving emergency support to command customers, GEEIA developed project TRUST (transportable units and self-sufficient teams). This is a GEEIA plan to fulfill that part of GEEIA's mission which calls for quick reaction capability. TRUST consists of four basic components: installation and maintenance teams constantly on alert; life support equipment; tools, material and ground transportation; and, most important of all, airlift support. Under the TRUST concept, the GEEIA installation-maintenance squadrons maintain teams on constant 24-hour alert, with bags packed,

(Continued on Page 20)

MEETINGS AND SYMPOSIA

FEBRUARY 1966

Syposium on **Radioisotope Applications in Aerospace**, Feb. 15–17 (corrected date), at Biltmore Hotel, Dayton, Ohio, and Wright Patterson AFB, Ohio. Co-sponsors: Air Force Flight Dynamics Laboratory and Atomic Energy Commission (Radiation Applications Branch, Isotopes Development Div.). Contact: Dr. Paul Polishuk, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, 45433.

Interdisciplinary Aspects of Radioactive Energy Transfer, Feb. 24–26, at the Sheraton Hotel, Philadelphia, Pa. Sponsor: Office of Naval Research. Contact: Morton Cooper, Office of Naval Research (Code 438), Department of the Navy, Washington, D.C. 20360, (Area Code 202) OXford 6-6839.

MARCH 1966

National Conference on **Space Maintenance and Extra Vehicular Activities**, March 1–3, at the Meyer Motor Inn, Orlando, Fla. Co-sponsors: Air Force Aero Propulsion Laboratory and Martin Co. Contact: Mr. E. May (APFT), Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio 45433, (Area Code 513) 253-7111, ext. 2-7107.

Symposium on the **Coupling of Basic and Applied Corrosion Research**, March 21–22, at the National Bureau of Standards, Washington, D.C., and Gaithersburg, Md. Co-sponsors: Office of Naval Research Laboratory and National Bureau of Standards. Contact: Dr. Richard C. Carlston, Office of Naval Research, Department of the Navy, Washington, D.C. 20360, (Area Code 202) OXford 6–1801.

Conference on **Functional Analysis**, March 28-April 1, at the University of California, Irvine, Calif. Co-sponsors: Air Force Office of Scientific Research and the University of California. Contact: R. G. Pohrer (SRMM), Air Force Office of Scientific Research, Tempo D, 4th St. and Independence Ave., S.W., Washington, D.C. 20333, (Area Code 202) OXford 6–5248.

Second International Symposium on **Aerobiology**, March 29–30, at Chicago, Ill. Co-sponsors: U.S. Army and Illinois Institute of Technology Research Institute. Contact: Elwood K. Wolfe, Director of Technical Services, Fort Detrick, Frederick, Md., (Area Code 301) 663–4111, ext. 2214.

Low Speed Aerodynamic Problems Associated with **Helicopters and V/STOL Aircraft**, March 30-April 1, at Buffalo, N.Y. Co-sponsors: U.S. Army Aviation Materiel Laboratories and the Cornell Aeronautical Laboratory. Contact: John E. Yeates, Chief, Aeromechanics Div., Army Aviation Materiel Laboratories, Fort Eustis, Va. 23604, (Area Code 703) 878-4101.

APRIL 1966

Second Symposium on **Marine Bio-Acoustics**, April 6–8, at American Museum of Natural History, Central Park West at 79th St., New York City and Naval Training Device Center, Port Washington, N.Y. Sponsor: Naval Training Device Center. Contact: F. E. Wolf, Jr., Research Program Manager, Naval Training Device Center, Port Washington, N.Y. 11050, (Area Code 516) PO 7–9100, ext. 550.

Conference on Ground-Based **Aeronomic Studies of the Lower Ionosphere**, April 11–15, at the Defense Research Telecommunications Establishment (DRTE), Ottawa, Canada. Co-sponsors: Air Force Cambridge Research Laboratories and DRTE. Contact: W. Pfister (CRUB), Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Mass. 01731, (Area Code 617) CR 4–6100, ext 3019.

Symposium on **Generalized Networks**, 14th in a series of international symposia organized by the Polytechnic Institute of Brooklyn, Microwave Research Institute, April 12–14, at New York City. Sponsors: Air Force Office of Scientific Research, Office of Naval Research, Army Research Office, Society for Industrial and Applied Mathematics and the Institute for Electrical and Electronics Engineers. Contact: Lt. Col. E. P. Gaines, Jr., (SREE), Air Force Office of Scientific Research, Tempo D, 4th St. and Independence Ave., S.W., Washington, D.C., (Area Code 202) OXford 6–3671.

Twentieth Annual **Frequency Control** Symposium, April 19–21, at the Shelburne Hotel, Atlantic City, N.J. Sponsor: Army Electronics Laboratories. Contact: M. F. Timm, Solid State & Frequency Control Div., Army Electronics Laboratories, Fort Monmouth, N.J., (Area Code 201) 5-1728.

Mathematical Aspects of Computer Science, dates undetermined, at New York City. Sponsors: Air Force Office of Scientific Research, Army Research Office-Durham, Institute for Defense Analyses, Association for Computing Machinery, Association for Symbolic Logic and the American Mathematical Society. Contact: Capt. J. Jones, Jr. (SRMA), Air Force Office of Scientific Research, Tempo D, 4th St. and Independence Ave., S.W., Washington, D.C. 20333, (Area Code 202) OXford 6–1302.

MAY 1966

Symposium on **Electrode Processes**, May 1–6, at Clevelond, Ohio. Co-sponsors: Air Force Office of Scientific Research and the Electrochemical Society, Inc., Contact: Lt. Col. M. D. Sprinkel (SRC), Air Force Office of Scientific Research, Tempo D, 4th St. and Independence Ave., S.W. Washington, D.C. 20333, (Area Code 202) OXford 6–8706.

Bionics Symposium 1966, May 3–5, at the Sheraton Hotel, Dayton, Ohio. (rescheduled from March 1966) Co-sponsors: Aerospace Medical Research Laboratory, Aerospace Medical Div.; and Avionics Laboratory, Air Force Research and Technology Div. Contact: Dr. H. L. Oeistreicher (MRBAM), Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio, (Area Code 513) 253-7111, ext. 3–6108.

Ninth **Navy Science** Symposium, May 5–6, at Departmental Auditorium, Consitution Ave., between 12th and 14th Streets, N.W., Washington, D.C. Sponsor: Office of Naval Research. Contact: Robert J. Mindak, Conference Chairman, Office of Naval Research, Department of the Navy, Washington, D.C. 20360, (Area Code 202) OXford 6–4720.

SPRING 1966

Second International Symposium on **Airborne Infection**, dates undetermined, at Baltimore, Md. Co-sponsors: Department of the Army and the Johns Hopkins School of Medicine. Contact: Elwood K. Wolfe, Director of Technical Services, Fort Detrick, Frederick, Md., (Area Code 301) 663–4111, ext. 2214. (Rescheduled from Oct. 20–21, 1965).

Around the Horn from MIL-D-5028 to MIL-D-1000

by
Jack L. Flippo
Chief, Contractor Data Management Office
Headquarters, Air Force Logistics Command

Over a period of many years, the preparation and acquisition philosophy of engineering documentation by the Defense Department has been undergoing an evolutionary change. To some this evolution appears revolutionary. We could evaluate this change as "going around the horn" or, in the military vernacular, doing a "one-eighty" degree turn.

Historically, engineering documentation has been prepared in support of research and development, production, manufacturing and testing. Its main purpose has been to provide a means of translating information from the engineering arm to the drawing board in such a manner that it could be used by either the manufacturing or procuring activities, as appropriate. Perhaps a better way of expressing it would be to say, "engineers do not design drawings"—they design things; the drawings then become the pictorial delineation of those things.

The Air Force, for many years, has been using a variety of specifications to advise contractors how to prepare their engineering drawings in support of the items that the military buys. This is especially true when the military is paying for the design of purely military hardware.

Let us begin with the year 1953, when the first of these specifications, MIL–D–5028 (ASG), was issued. The "A" revision was issued in 1954 and the "B" revision in 1956. MIL–D–5028 was a dynamic document which underwent numerous changes during a relatively unchanging time when viewed in terms of the present day situation. The scope of the specification covered "the preparation of manufacturers' engineering design drawings, as defined in Section 6, and related data lists for the production of aeronautical and associated equipment." Paragraph 6.1 of the specification, titled "Intended Use," stated, "Drawings and data lists covered by this specification are for engineering evaluation of the articles, identification of stock, ordering and storing replacement parts, inspection of articles at overhaul, and general maintenance of equipment in service."

In no instance did the specification specifically state or imply that the data was to be used for competitive reprocurement. In those days it was always assumed by contractors that the drawings were being furnished to the Government for support of the intended uses, unless otherwise specified in the contract.

In 1957, the Air Force, in order to improve its competitive position, developed MIL–D–26085, initiating the Air Force Control Drawing Program commonly referred to as the AFCON Drawing Program. The AFCON Drawing Program cited MIL–D–5028 as an applicable document, but it substantially expanded the intended use to include procurement by incorporating such statements as "are intended to be used as a portion of the reprocurement data." The whole idea of the AFCON Drawing Program was not only to obtain engineering data suitable for engineering evaluation, but to assure that it was suitable for use by any manufacturer who would normally produce such items.

Before the Air Force was actually able to gain experience and prove or disprove the worth of the AFCON Drawing Program, MIL–D–70327 was released. This specification was heralded by both industry and DOD as the ultimate in standardization covering drawing preparation by the Department and its contractors.

Paragraph 6.1 includes two concepts in particular which had not been a part of previous specifications. First, the data acquired by the Government was "subject to rights-in-data acquired under the contract." This action now tied the acquisition of the data to the Armed Services Procurement Regulation, Section IX, Part 2, hereafter referred to as ASPR. Secondly, it expanded the intended use to specifically state that the specification may be used by DOD activities for *procurement, production* and *manufacturing*, as well as some 15 other intended uses. It also included the statement, "and wherever engineering drawings are needed."

At about this time, the now famous Secretary Pike memorandum, directing the Military Departments to increase or rather optimize competitive procurement, was issued. This memorandum had the effect of directing the Military Departments to initiate action to assure optimum competitive procurements. Upon release of MIL–D–70327, the revised ASPR policy, and the DOD stated policy "that the Military Services will optimize competitive procurement," the Air Force went all out to achieve the DOD objective of maximizing competitive procurements. This was evident by ordering drawings under the specification with the *intended use* of using them for manufacturing via the competitive procurement process.

Shortly after the release of MIL–D–70327, the Air Force suspended any further implementation of the AFCON Drawing Program. This action was directed by DOD on the assumption that MIL–D–70327 provided the necessary tools to order engineering documentation in support of the competitive procurement processes.

While the engineering drawing program was going through the MIL–D–70327 evolutionary stage, a similar effort was undertaken to rewrite ASPR. The revised ASPR provided a broad definition of data and introduced the term "proprietary rights." The new version defined the conditions and limitation under which R&D contractors would be required to furnish data under research and development.

Supply contracts were similarly defined. In general, it can be said that under supply contracts the contractors were not required to release their proprietary data to the Government, and so the capability of the Government to obtain data for competitive procurement was adversely affected. This was not a good sign but, even more important, the military capability of getting adequate data for follow-on logistic support missions, other than reprocurement, was also threatened. The ASPR became very articulate as to the conditions under which contractors were obligated to release so-called proprietary data to the Government.

As the new ASPR policy on acquisition and conditions under which contractors were required to furnish their drawings to the Government, coupled with the drawing preparation requirements of the military, began to unfold, two distinct opposing philosophical forces began to emerge. On the one hand were the desires and policy direction from DOD to the Military Services stating, in effect, that in the interest of economy the Government must obtain data suitable for competition to the maximum extent practical, subject to rights-in-data. On the other hand, trade associations and certain companies became very adamant in their position with regard to furnishing data to the Government on the premise that they did not condone other manufacturers producing and furnishing items to the Government over which they had engineering and design cognizance.

After four or five years of the new ASPR and MIL–D–70327, it became apparent that, although they represented the best mix yet developed, further refinement was necessary. For example, industry and military leaders began to complain that requirements of MIL–D–70327 were gold plated and that there were too many Service implementing documents. Also, there was a belief that

MIL–D–70327 was excessively restrictive and that grades of documentation, based on the need, could be produced at lower costs. Other industry associations and companies complained of the specification Christmas tree.

While all this was going on, other contractors were complaining about the Government usurping their proprietary rights. The subject of proprietary rights became one of the leading issues of the day between the military and industry. It should be brought out here that it was not providing engineering drawings to the Government, but rather the legal right to disclose the data as an example in reprocurement packages, that was at issue.

The Air Force exercised great care and enthusiasm in attempting to improve its competitive position in the industrial community. To cite a few of the programs to improve competition, the Air Force required contractors to provide information concerning methods of procurement and, where feasible, to provide procurement data packages. It initiated a comprehensive program to review drawings on hand to determine their usability for competitive procurement.

Industry reacted strongly to these Air Force efforts to increase competitive procurement. Industry opposition became evident almost immediately. Contractors began removing so-called proprietary information from drawings, would not sign contracts which required the delivery of any data and placed prices on data which were tantamount to "not for sale." It was soon apparent that a serious breakdown of engineering data communication between the Air Force and its contractors was imminent.

To eliminate or reduce the problems, the Air Force initiated two major programs. The first was known as the Air Force's "Competition with Confidence" program. This was a program by which the Air Force and its contractors determined, at the time of provisioning (or at some mutually acceptable time during production), those items which were susceptible to competition. The second was the "Deferred Delivery of Engineering Documentation" program designed to leave the engineering documentation, which normally would have been delivered to the Government, with the contractor but making provisions for Air Force activities to order the engineering documentation direct from the contractor engineering data files on an "as required" basis.

At about the same time, the Air Force Contractor Data Management Program, herein referred to as the 310–1 program, was born. Under the 310–1 program discrete items of data were developed against specific missions to be supported by the drawings. Under the old program, MIL–D–5028, it was the general practice of the Air Force to buy complete sets of engineering documentation. Later, under the MIL–D–70327 program, even though the policy was to be more selective in that only that data which was specifically required need be ordered, the military continued to request a complete set of engineering data.

While the Air Force was in the process of implementing the new Contractor Data Management Program under the joint Air Force Systems Command/Air Force Logistics Command Manual 310–1, DOD, as a result of the concerted efforts of industry, undertook two major projects. The first of these projects was the rewrite of ASPR to remove the proprietary rights problems. The other project was the revision of MIL–D–70327 to provide: (1) simplified drawing practices which would incorporate the absolute minimum preparation instructions; (2) a standard requirements document which could be incorporated in the specification, thereby eliminating such documents as the Navy WR–12 and the Air Force MCP 71–77; and (3) a quality control or acceptance method to validate that the ordering activity was, in fact, getting what it ordered and to assure it got that for which it paid. These two projects culminated in the release of ASPR and the release of MIL–D–1000, dated March 1, 1965, with a supporting MIL–STD–100, same date.

MIL–D–1000 will provide the Government a new basis of negotiating with contractors and also more flexibility between the Government and industry in ordering engineering data. It will permit the Government to order (1) data for a specific intended use and (2) drawings which do not fully comply to the requirements of MIL–STD–100 and other standards specified in MIL–D–1000. It will minimize the requirements to prepare drawings to exacting specifications and hopefully will provide drawings to intended use, as opposed to the previous practices of ordering a complete set drawn to exacting standards called for by MIL–D–70327.

MIL–D–1000 is a real step forward. However, a few words of caution are in order. First, there appears to be a false assumption inherent in the drawings preparation specification under intended use. MIL–D–1000 may cost the Government more money because when ordering drawings the Government specifies one or more of the 10 categories. Contractors will now need to review their drawings to determine whether or not they are suitable for the intended use specified. As previously stated, contractors prepare their drawings in support of their design and productions, not in support of the military follow-on logistic missions after production. A few examples are provided for explanatory purposes:

• Under Category D contractors must furnish on their drawings "details of performance characteristics, and quality levels and test requirements when necessary to differentiate between similar items." Is this type of information normally contained on production drawings?

• Under Category G—Installation—drawings must contain "auxiliary equipment and facility requirements; safety precautions; and human engineering considerations." Most people will agree that these types of things are rarely contained on drawings, but are normally contained in other documentation maintained by the contractors.

• Under Category E—Procurement (identical items)—drawings "shall include, as applicable, but shall not necessarily be limited to: details of unique processes essential to design and manufacture; details of performance ratings; evaluation requirements and criteria." Is this information normally contained on the drawing? If not, additional costs will be incurred in making it a part of the drawing package in support of advertised procurement by the Government.

The next area of caution concerns the requirement to specify (paragraph 3.1, MIL–D–1000) at time of contract award both category and form for each item. The technique for implementing this requirement appears as a real problem area when viewed in terms of how to specify category and form for each item of supply at the time of contract award. This occurs at a time when you don't know what the item is, how the item will be reproduced, how the item will be re-manufactured, etc., and, in the case of vendor items, who is the vendor and who are his subvendors.

Another consideration which will take time to smoke out will be the real impact of the new "private expense" philosophy expressed in the new ASPR. Naturally this will have a strong bearing on the effectiveness and ability of the Government to procure adequate data in support of the Government reprocurement programs and logistic support.

Thus, we have been "around the horn." Changes have been made in the entire DOD acquisition philosophy for engineering data. This philosophy has gone from one of saying, "Please give me a complete set of engineering data for intended uses, as cited in MIL–D–5028," to one of saying, "Give me only that portion of your engineering data files required to support specific missions plus either furnish or prepare additional data to meet the intended use categories when specified in the contract."

Hopefully, the latter approach will provide data vital to logistic support once the military has acquired operational quantities of weapons systems and the contractor has ceased to maintain a design and production capability.

SPEAKERS CALENDAR

OFFICE OF THE SECRETARY OF DEFENSE

Dr. Thomas P. Cheatham, Jr., Dep. Dir. (Tactical Warfare Programs) Office of Dir., Defense Research & Engineering, at Assn. of the U. S. Army Target Acquisition & Surveillance Symposium, Ft. Huachuca, Ariz., Jan. 25.

Hon. John S. Foster, Jr., Dir., Defense Research & Engineering, at Institute of Electrical & Electronics Engineers 1966 Winter Convention on Aerospace & Electronic Systems, Los Angeles, Calif., Feb. 3.

Mr. William B. Petty, Dir., Defense Contract Audit Agency, at National Contract Management Assn. Meeting, Philadelphia, Pa., Feb. 8; at Southeastern Government Procurement Symposium of the National Contract Management Assn., Orlando, Fla., March 3 or 4.

Mr. Daniel J. Fink, Dep. Dir. (Strategic & Space Systems), Office of Dir., Defense Research & Engineering, at American Astronautical Society Meeting, Washington, D.C., March 15.

Lt. Gen. William J. Ely, USA, Dep. Dir. (Administration & Management), Office of Dir., Defense Research & Engineering, at Industrial College of the Armed Forces, Washington, D. C., April 7.

DEPARTMENT OF THE ARMY

Lt. Gen. William F. Cassidy, Chief of Engineers, at the Society of American Military Engineers Meeting, The Citadel, Charleston, S. C., Feb. 9.

Maj. Gen. David P. Gibbs, Chief of Communications Electronics, at Armed Forces Communications Electronics Assn. Meeting, Ft. Monmouth, N. J., April 4–6.

DEPARTMENT OF THE NAVY

VAdm. I. J. Galantin, Chief of Naval Material, at Navy League Meeting, Los Angeles, Calif., Jan. 28.

Capt. Walter F. Mazzone, Officer-in-Charge, Navy Medical Research Laboratory, Groton, Conn., at Annual Dinner of Central Illinois Chapter of the Society of Professional Engineers, Decatur, Ill., Feb. 22.

DEPARTMENT OF THE AIR FORCE

Hon. Harold Brown, Secretary of the Air Force at Air Force Assn. Convention, Dallas, Tex., March 24–25.

Gen. J. P. McConnell, Chief of Staff, at Air Force Assn. Convention, Dallas, Tex., March 24–25; at Arnold Air Society National Conclave, Dallas, Tex., April 6; at The Citadel, Charleston, S. C., April 16.

Gen B. A. Schriever, Commander, Air Force Systems Command, at Achievement Rewards for College Scientists Annual Science Ball, Los Angeles, Calif., April 2; at American Institute of Aeronautics & Astronautics and American Society of Mechanical Engineers Meeting, Cocoa Beach, Fla., April 19.

DCASR Activation Completed

Defense Contract Administration Services Regions (DCASR's) were activated at Los Angeles and San Francisco on Dec. 1, thereby completing a nationwide network of personnel performing contract administration services for the Army, Navy, Air Force and the Defense Supply Agency.

The first of a total of 11 DCASR's was established at Philadelphia in August 1964. Detroit was activated in April 1965 followed by Dallas, Boston, Cleveland, Atlanta, Chicago, St. Louis and New York.

The 11 DCASR's administer Defense contracts for the military buying agencies nationwide. This work includes pre-contract award surveys of contractors' facilities and financial status, quality assurance, security clearance for plants and personnel, payments to contractors and similar functions required by the Government during the manufacture and maintenance of defense materiel.

Following is a list of the 11 Defense Contract Administration Services Regions including addresses and telephone numbers:

DCASR, Atlanta
3100 Maple Drive NE
Atlanta, Ga. 30305
(Area Code 404) 261–7310

DCASR, Boston
666 Summer St.
Boston, Mass. 02210
(Area Code 617) 542–6000

DCASR, Chicago
O'Hare International Airport
P.O. Box 8758
Chicago, Ill. 60666
(Area Code 312) 296–4411

DCASR, Cleveland
1367 East Sixth St.
Cleveland, Ohio 44114
(Area Code 216) TO 1–4960

DCASR, Dallas
500 South Ervay Street
Dallas, Tex. 75201
(Area Code 214) RI 9–2371

DCASR, Detroit
1580 East Grand Blvd.
Detroit, Mich. 48211
(Area Code 313) 923–0100

DCASR, Los Angeles
11099 La Cienega Blvd.
Los Angeles, Calif. 90045
(Area Code 213) SY 6–0471

DCASR, New York
770 Broadway
New York, N.Y. 10003
(Area Code 212) OR 7–3030

DCASR, Philadelphia
2800 South 20th St.
Philadelphia, Pa. 19101
(Area Code 215) 271–2000

DCASR, St. Louis
4300 Goodfellow Blvd.
St. Louis, Mo. 63120
(Area Code 314) EV 2–8200

DCASR, San Francisco
866 Malcolm Road
Burlingame, Calif. 94010
(Area Code 415) 692–0300

Military Construction Deferred

Secretary of Defense Robert S. McNamara has announced that $620,000,000 worth of military construction projects will be temporarily deferred including the building of 8,500 military housing units worth $160,000,000.

At the same time, Secretary McNamara gave the go-ahead for $686,000,000 in Army, Navy, Air Force and Marine Corps high priority military construction projects in 36 states, the District of Columbia and at 16 overseas locations.

Defense Secretary McNamara, in making the announcement, emphasized that all projects immediately essential for the combat support of the armed forces and those urgently required for safety, health, or other compelling reasons will proceed as scheduled.

The decision to defer projects located in 42 states, the District of Columbia and 16 sites outside the United States results from a new review of DOD expenditures focused on immediate requirements in direct support of combat forces in Vietnam.

The construction projects to be delayed for the most part are either long-planned replacements or improvements for existing facilities. The deferred projects, although necessary and desirable, can be undertaken at a later date without impairing military operations or effectiveness.

Defense Speakers Announced for DOD-NSIA Advanced Planning Briefings

The following Defense Department speakers at the 1966 DOD-National Security Industrial Association Advanced Planning Briefings for Industry have been announced by Deputy Secretary of Defense Cyrus Vance. At press time, speakers representing industry and labor organizations had not been announced. Names of these speakers will be carried in the February issue.

FIRST DAY

DOD Keynote Address: Major objectives of the DOD and the program designed to implement them. The changing patterns in Defense spending and the resulting problems and opportunities.

Speakers:

Hon. Paul R. Ignatius, Asst. Secretary of Defense (Installations & Logistics), at Boston, March 3; at Washington, D.C., April 27.

Hon. Robert N. Anthony, Asst. Secretary of Defense (Comptroller), at Atlanta, March 9.

Hon. Alain Enthoven, Asst. Secretary of Defense (Systems Analysis). at St. Louis, March 16.

Hon. John S. Foster, Jr., Dir., Defense Research & Engineering, at San Francisco, April 12.

The Technological Challenge of the Next 10 Years: Future opportunities for industry in all areas of defense research and development.

Speakers:

Daniel J. Fink, Dep. Dir. for Strategic & Space Systems (Defense Research & Engineering), at Boston, March 3.

Lt. Gen. William J. Ely, Dep. Dir. for Administration & Management (Defense Research & Engineering), at Atlanta, March 9.

Dr. Thomas P. Cheatham, Jr., Dep. Dir. for Tactical Warfare Programs (Defense Research & Engineering), at St. Louis, March 16.

Dr. Chalmers W. Sherwin, Dep. Dir. for Research & Technology (Defense Research & Engineering), at San Francisco, April 12.

Thomas F. Rogers, Dep. Dir. for Electronics & Information Systems (Defense Research & Engineering) at Washington, D.C., April 27.

Systems Analysis and Cost Effectiveness: A discussion of the extensive use of systems analysis techniques within DOD to assist in the efficient allocation of Defense resources and the reasons why these techniques have been introduced. An exploration of the implication of this development for Defense industry.

Speakers:

Russell Murray II, Dep. Asst. Secretary of Defense for General Purpose Programs (System Analysis), at Boston, March 3; at Atlanta, March 9.

Dr. Victor K. Heyman, Asst. for Special Projects (Systems Analysis), at St. Louis, March 16.

Hon. Alain Enthoven, Asst. Secretary of Defense (Systems Analysis), at San Francisco, April 12.

Fred S. Hoffman, Dep. Asst. Secretary of Defense for Strategic Programs (Systems Analysis), at Washington, D. C., April 27.

Resource Management Systems: DOD efforts to obtain integration and coordination among the multiple Defense management programs with emphasis on management of major capital acquisitions—Selected Acquisitions Information and Management System (SAIMS)—and the participation therein of Defense contractors. Current activity and future planning in the components of SAIMS to include Cost Information Reports (formerly CEIS) and Contract Performance Measurement.

Speaker:

George W. Bergquist, Special Asst. for Asset Management Systems (Comptroller), at all five cities.

Management Trends in Defense Research & Development: ODDR&E efforts to clarify R&D management concepts and intent including both clarification and integration of all management policies affecting the conduct and desired operating environment of R&D; emphasis on integration of direct R&D policies with related policies such as System/Project Management, Configuration management, Total Package Procurement and Contract Definition.

Speaker:

James W. Roach, Asst. Dir. for Engineering Management (Defense Research & Engineering), at all five cities.

Procurement Management Trends: Contracting trends, with emphasis on the impact of new or revised management techniques planned or under development such as Contractor's Weighted Average Share in Risk (CWAS), Total Package Concept, Life Cycle Costing, extension of Contractor Performance Evaluation and profit opportunities under the new Value Engineering clauses; the Small Business and Contractor Cost Reduction Programs; Defense industry profits.

Speaker: John M. Malloy, Dep. Asst. Secretary for Procurement (Installations & Logistics), at all five cities.

Defense Supply Agency — Procurement Trends and Future Industry Relationships: The functions of the Defense Supply Agency, its purchasing and contracting objectives and the markets it offers for business and industry.

Speaker: VAdm. Joseph M. Lyle, USN, Dir., Defense Supply Agency, at all five cities.

SECOND DAY

Army Advanced Planning Requirements: The Army's materiel and research and development requirements based on the concepts of move, shoot, communicate and see; the present and future opportunities for business to provide the hardware and research and development in these areas.

Speakers: (At all five cities)

Hon. Robert A. Brooks, Asst. Secretary of the Army (Installations & Logistics).

Gen. Frank S. Besson, Jr., USA, CG, Army Materiel Command.

Maj. Gen. John G. Zierdt, USA, CG, Army Missile Command, Redstone Arsenal, Ala.

Maj. Gen. William W. Lapsley, USA, CG, Army Mobility Command, Warren, Mich.

Maj. Gen. Roland B. Anderson, USA, CG, Army Weapons Command, Rock Island, Ill.

Maj. Gen. Floyd A. Hansen, USA, CG, Army Munitions Command, Dover, N.J.

Brig. Gen. William B. Latta, USA, CG, Army Electronics Command, Fort Monmouth, N.J.

Navy Advanced Planning Requirements: A forward look at Navy and Marine Corps research, development and procurement: a forecast of material requirements for support of the Navy and Marine Corps, and a review of opportunities for business to provide the weaponry and warfare systems the Navy and Marine Corps will require in the future.

Speakers:

Hon. Robert W. Morse, Asst. Secretary of Navy (Research & Development) at Boston and Atlanta.

Hon. Graeme C. Bannerman, Asst. Secretary of Navy (Installations & Logistics), at St. Louis, San Francisco, and Washington, D.C.

(At all five cities)

VAdm. I. J. Galatin USN, Chief of Navy Material.

RAdm. A. M. Shinn USN, Chief of Bureau of Naval Weapons.

RAdm. Edward J. Fahy USN, Chief of the Bureau of Ships.

Brig. Gen. Wood B. Kyle USMC, Headquarters, U.S. Marine Corps.

Air Force Advanced Planning Requirements: The role and opportunities for business and industry in the Air Force-industry team. A broad look at present and forecasted requirements of the Air Force in research, development and logistics support with emphasis on research and technology plans and the translation of operational requirements into development planning. Near-term research, development and logistics support procurement pro-

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FROM THE SPEAKERS ROSTRUM

Ronald M. Murray

Address by Ronald M. Murray, Assistant Director (International Programs), Office of the Director of Defense Research and Engineering at American Institute of Aeronautics and Astronautics, Royal Aeronautical Society, and Japanese Society for Aeronautical and Space Sciences Aircraft, Design and Technology Meeting, Los Angeles, Calif., Nov. 17, 1965.

International Cooperation in the Development of Military Aircraft

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The Reason for Cooperation.

I would like to begin by asking a question which our foreign friends sometimes ask us. It goes like this: "Since the United States military R&D budget is much larger than that of any of its allies, why are you interested in cooperating with us in R&D? What's in it for you?" A formal answer would quote from the Department of Defense directive (DOD Directive 3100.3) which in September 1963 spelled out our objectives for international cooperation to be as follows:

"The U.S. will cooperate with its allies to the greatest degree possible in the development of defense equipment, where such cooperation is in the overall best interests of the United States. The objectives of such cooperation will be:

"1. To make the best equipment available to the U.S. and its allies in the most timely manner.

"2. To increase the effectiveness of the scientific and technical resources of the U.S. and its allies, especially by eliminating unnecessary and wasteful duplicating of effort.

"3. To achieve the maximum practicable degree of standardization of equipment.

"4. To create closer military ties among the alliance."

I believe these reasons for cooperation are indisputable, important and general. To be more specific, in your own field of military aircraft, I would like to offer you two reasons for cooperation which are more closely related to your everyday work technology and money.

What do we mean by technology? While indeed the American aircraft industry has much to be proud of in its technology and its accomplishments, it certainly must acknowledge the very excellent technical work done in other countries in recent years, resulting often in advances in fields in which we have been working and, sometimes, in fields which we ourselves have not been pursuing as hard as they. There are many paths to success, and breadth of approach is an important parameter before a final decision and selection is made.

Consider the field of V/STOL, which is one of those in which we are most active in cooperation with our allies. Look at some of the unique developments of the other countries. For example, we have in Great Britain the vectored thrust P–1127 V/STOL fighter; in France, the high-performance Mirage III–V, using a combination of lift and cruise engines; in Germany, the supersonic VJ–101, with its excellent system of engine thrust modulation for attitude control in the transitional modes. And look at the work which Japan has done in the application of STOL techniques to seaplanes—an area, to my knowledge, not covered by those of us in the Western world.

Obviously, we would have much to gain from cooperation in the V/STOL field and we have much to offer our partners from our own experimental V/STOL programs, as well as from our general base of aircraft technology.

Now as to money. I am sure you all know better than I the great increase in the cost of the development of military aircraft, the resulting strains on the development budgets and, since our budgets do have finite limits, the limitations in the number of aircraft projects we can afford to pursue. For example, consider the cost of developing fighter aircraft. The F–86, which first flew in 1948, cost under $100 million to develop. Its big brother, the F–100, which first flew in 1953, cost around $200 million to develop. Flying two years later, the F–105 cost about $400 million to develop. And now, first flying in 1964, the F–111 will cost about double the F–105 to develop. So there has been an increase in development cost from the F–86 to the F–111 of nearly an order of magnitude. Obviously, it is essential for each of us, regardless of how large our R&D budgets are, to economize as much as we can in development costs, and obviously one logical way of doing this is to share the load with other people who have similar interests and similar competence in the field. The whole is greater than the sum of its parts, if we cooperate—and the free world must do this if we are to stay free.

The Ways of Cooperation.

Now that you are convinced that cooperation in the development of military aircraft is highly desirable, consider the ways in which we in DOD believe that cooperation is practical.

The oldest form of inter-governmental cooperation, beginning intensively in World War II, is the exchange of technical information. This is done in a variety of ways, such as by formal government-to-government data exchange agreements, by exchange visits and by participation in multi-national symposia like the V/STOL symposium sponsored by the Advisory Group for Aerospace Research and Development (AGARD) in NATO last year.

During the last several years, the main aim of DOD has been to work out sharing of development projects, and we have been moderately successful in this. To illustrate, I would like to describe four different projects in the aircraft field that cover pretty well the more likely ways of cooperation.

Starting upstream in the development cycle, we entered into an agreement a year ago with the United Kingdom for cooperative work in the experimental application of beryllium to jet engines. You probably are familiar with the properties of beryllium which make it a highly promising but challenging material for lightweight applications. Cooperating with the British on the application of beryllium was a natural. They had done a lot of work in the refinement of beryllium to very high purities, while U.S. contractors had done much in forging, machining and joining techniques. We each agreed that we

both would be better off by pooling these different capabilities and experience for the experimental application of beryllium to engine components. We agreed to share the costs, the work and the results of nine specific tasks in materials improvement and five tasks in engine applications. There are now a total of 10 U.S. and U.K. contractors and laboratories working on this project, with the promise of very real benefits to all.

Now, let's move downstream one notch to advanced development projects. Some of you are familiar with the joint design studies that the Air Force and the Federal Republic of Germany are having performed on high-performance, advanced V/STOL strike fighter aircraft. There are four U.S. firms and two German firms doing these studies, which will be completed in the spring of 1966. In these, the U.S. contractors are drawing upon their extensive V/STOL studies, such as ADO–12, their various experimental programs and their advanced technology for high-performance aircraft. German contractors are drawing upon their own studies of V/STOL operation in the European theater, their design work on several V/STOL fighters and the flight testing of the VJ–101. And the joint design studies were preceded by joint military studies to define the optimum mission specifications.

The Germans and we expect the joint design studies to give the best possible indication of the capabilities and usefulness of high performance strike V/STOL aircraft for the 1970's. With this information and considering the military and cost aspects, both we and the Federal Republic should be able to make our decisions next year as to whether to go into the development of prototypes. Whatever the outcome, we should both be in a more knowledgeable position to reach our national decisions as a result of having looked at the problems jointly.

Moving now from joint design studies to joint development projects, we recently concluded a detailed agreement with the United Kingdom for the development of an advanced lift engine for V/STOL applications. Here again we each have something to offer the other which should make our combined effort better than either of our individual efforts. The British contractor, Rolls-Royce, is the only company in the world that has had practical flying experience with jet lift engines. Through several different engine models, Rolls has provided the lift for British, German and French V/STOL's. At the same time, our engine contractors have for several years been working on advanced technology for lightweight jet engines, and four of our contractors have recently built test-rig demonstrators incorporating this technology to demonstrate thrust-to-weight ratios heretofore unattainable. The pooling of this complementary experience and knowledge, in a joint development project on an important and critical equipment, fulfills in the most direct way possible the DOD objectives of R&D cooperation.

Another kind of cooperation takes place on those things where we have each already done development and have built prototypes of equipment of mutual interest. For example, we have agreements and programs for joint flight testing of a variety of V/STOL aircraft between ourselves and Germany, France and the United Kingdom. We each will get both data and first-hand experience with aircraft that exist only in one country.

So we see that our cooperation in the development of military aircraft so far takes place in scientific interchange, in design studies, experimental fabrication, engineering design and flight evaluation.

The U.S. Ground Rules for Cooperation.

These various types of cooperation are worked out to meet the objectives and criteria specified in the DOD directive referred to before. The main ones are these:

• **First, for U.S. funds to be committed, there must be a U.S. need for the particular project.** I stress the word *need* here as contrasted to "requirement." What is meant is that there must be the same degree of firmness of application for a joint project that there is for a similar category of domestic project. The required need varies from a technical need for an exploratory development project, to a hardware evaluation need for an advanced development project, to an approved military need for an engineering development project. The fact that a project will be cooperative doesn't change our own RDT&E ground rules.

• **Second, there must be adequate value to the United States in the project.** These projects are not military assistance projects in any way and good business practice dictates that in these projects both we and our partner expect to get equivalent return. The only good contract anywhere is one that is mutually profitable.

• **Third, funding for the project must come out of the regular RDT&E funds of a Military Department.** There are no DOD funds for international programs. These projects must carry their own weight in competing within the Services for the service R&D dollars.

• **Fourth, from jointly-funded projects, the United States must obtain design and production rights equivalent to those of U.S. projects.** This means that on jointly-funded projects we will end up with a complete technical data package and with the rights that are necessary to implement the production of it. For this, we agree to pay reasonable royalties on the background work performed in the other country before the joint project, but all work that is done under joint funding gives us our normal royalty-free license to use the project results for our own defense purposes. This includes our usual right to set up other contractors in the United States as alternative sources of supply, just as we normally have the right to set up second source contractors.

• **Fifth, and last, sales of the production resulting from cooperative projects must remain competitive.** This is in keeping with Secretary McNamara's belief in and work toward a common NATO defense market, based on the principles of competition rather than allocation and arrangement.

Another important prerequisite for cooperation, not stated in the DOD directive, is industrial compatibility, meaning that the competent contractors in each case must be amenable to working cooperatively. No matter how elaborate and harmonious the governmental agreement drawn up for a cooperative project, the project won't get off the ground unless the contractors agree to do business with their own governments and to work in cooperation with the other government's contractor. We believe that this usually should not be a problem, because of the increasing mutual interest in the U.S. and European aerospace industries in joint arrangements and projects. As you know, several major U.S. firms have industrial agreements with or ownership in European firms from which cooperation can easily develop. Secondly, an increasing number of projects in Europe are being done in cooperative fashion. The most outstanding example is that of the British-French cooperation on their supersonic transport, the Concorde. Following in that pattern are the Anglo-French projects for developing two new strike fighters, the Jaguar and the P–45. And in the V/STOL field, Germany and Italy are currently developing for operational use a light-weight V/STOL close-support fighter, the VAK–191B. Each of these projects is based upon industrial compatibility.

Now let's take a closer look at how the lift engine project satisfies these ground rules.

• **Is there a U.S. need for an advanced lift engine?** For a specific inventory requirement at this time, the answer is no. For preliminary design and component work to define and size the engines that could be developed for use in V/STOL's a few years from now, the answer is yes.

• **Is there value to the United States in the cooperation?** The answer is a resounding yes. We should both get a better engine and save a lot of R&D money.

• **Will it be funded out of service RDT&E funds?** Yes, out of U.S. Air Force advanced development funds.

• **Will the United States get design and production rights equivalent to a U.S. development?** Yes, the development work will be split between Rolls-Royce and the U.S. contractor to

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courage the acceptance of authority by subordinate personnel. Authority is more meaningful when it relates to the individual's ability to build alliances within his environment and to resolve conflicts within the organization.

Decision Making in Weaponry Selection.

In the development and acquisition of weaponry, critical decisions must be made by Government and industrial leaders. The decision by the Secretary of Defense to begin development and subsequent production of a major weapon system, e.g., a ballistic missile, involves forces and factors of extraordinary proportions. Involved in the acquisition of a weapon system are a host of divergent activities such as research, engineering, test, production, operational support, etc., all of which are time-phased over the life of the system. The result is a managerial activity involving the utilization of human and non-human resources extending over several years. The protracted development time on our modern weapons systems and the huge commitment of resources involved compounds the responsibility of the decision maker. Selection of a particular weapon system today determines to a large degree the battlefield strategy that will be employed in a future war and, to some extent, our national security. Decision making in the development of weapons encompasses manifold factors of cost, technology, master scheduling, produceability, maintainability, reliability, as well as operational suitability in the intended operational environment. Moreover, there is a critical interdependence between the industrial and defense participants involved in such decisions.

In this complex management problem are the roots of the two major innovations in or extensions of traditional management theory discussed herein, i.e., *project management* and the extensive use of *quantitative analysis* for decision making. A project management structure is superimposed upon the functional organization of the parent unit to provide a focal point for the decision and execution phases of management. The nature of the management job in weapons acquisition has forced the intergation of project management innovations and quantitative analysis in a framework of traditional management theory. Organizational theory and management principles provide a basic guide to planning, organizing and controlling human and non-human resources while analysis and the accompanying use ot quantitative methods provide for objectivity and the systematic and rigorous examination of the alternatives from which the manager has to choose. The truly significant result of this relationship has been the recognition that the execution aspects of management cannot be separated from analysis. A new breed of manager has been created to meet the challenge of this unique problem, one who combines the talents of the traditional manager with those of the analyst to become the *total manager*, capable of attacking the total management job!

It is superficial to view the schools of management introduced earlier as separate approaches to the management problem, or as several types of management. If they must be discussed separately at all, they should be viewed as segments of the integrated whole, segments which complement each other to fulfill that comprehensive management philosophy required of today's manager.

Quantitative Aspects of Management.

The central theme of the quantitative segment of management is the use of a formal analytical framework in the decision-making process, *usually* involving the use of quantitative methods. It is not addressed to a particular type of decision problem, i.e., that type which is predominantly concerned with variables which can be quantified, but to any type of problem. The proponents of quantitative methods are concerned about the depth of analysis for decision making and believe that a sound basic approach is the key to this depth of analysis. They would support the view of Harold Koontz quoted earlier that their philosophy does not represent a separate type of management. They would also take issue with the "tools" classification of the ideas they represent. While it is true that mathematics might logically be viewed as the tool of the analyst, the analytical approach to decision making advocated by this group cannot be viewed simply as a tool to be applied when and where the manager sees fit. Analysis must become an integral part of the management job, and the manager must be, to some extent, an analyst.

This is not to say the manager must be a professional mathematician or operations researcher. His knowledge of their areas need not be as extensive as those who specialize in this profession. He does, however, need a basic understanding of the logical processes involved, and the ability to understand and to formulate the analytical structure for his own decision. Given this level of competence, the manager can effectively utilize the professional analyst or operations researcher in his decision process. Only if he can do this can he really incorporate analysis in depth into his decision-making process. As Dr. Francis F. Bradshaw, former president of the Society for Advancement of Management, has said: "Most managers would rather live with a problem they can't solve than use a solution they don't understand." The role of the manager is that of understanding and participating in the analysis for decision making. This requires that he be able to communicate with and utilize the skills of the professional analyst.

The strongest proponents of quantitative analysis for management decisions are associated with organizations which carry a number of different titles. The most popular are Operations Research, Management Science and Systems Analysis. These terms do not have generally accepted definitions. It is possible to characterize the primary areas of interest of these groups by examining the journals carrying these titles and observing the activities of those persons who practice in these fields. One will find that in all of these fields the approach to the decision problem is identical, only the emphasis is different. A decision is viewed as the act of choosing from alternatives based on a prediction of the future consequences of each of the alternatives. The decision maker must be able to identify the alternatives open to him, make a prediction of the future consequences of each and determine a criterion upon which to base his choice. If the problem is very complex, a rigorous analysis is essential to good decision.

While the elements of a decision problem are alternatives, predictions and criteria, it is seldom that one has available any one of these elements in its entirety. A complete list of alternatives open to an individual about to make a decision would not only be impossible, it would be undesirable as it would unnecessarily complicate the decision making process. It is usually desirable to have the set of possible alternatives reduced to a workable size by elimination from consideration all but the most likely choices. Prediction of the future consequences of alternatives involves the inherent problems of predicting the future. The possibility of many outcomes always exists for each alternative and, in many cases, one is not even able to estimate with any degree of confidence the relative likelihood of the occurrence of any one of the possible outcomes. If these complexities did not complicate the decision maker's world enough. the problem of determining a suitable criterion of choice certainly would. Even in a deterministic world in which one could predict with certainty the outcome of each alternative, the criterion problem would be troublesome. Each outcome involves a cost (the expenditure of resources in the form of time, effort, or material) as well as a number of desirable and undesirable effects. Establishing a criterion for selection from such a complex of outcomes involves making value judgments and balancing conflicting goals. It is probably because of these complexities that the operations researchers, the management scientists and the systems analysts emphasize different aspects of the problem.

Operations researchers have developed into a rather highly mathematically oriented group. An examination of the *Journal of the Operations Research Society of America* will reveal that the preponderance of the articles are primarily mathematical in nature. This group tends to emphasize the development of mathematical techniques for finding optimal solutions to problems as given rather than on the development of new models for real problems.

As indicated by *Management Science*, the journal of the Institute of Management Sciences, the term management science is associated with a more problem-oriented study of the decision process. While containing a sizable amount of mathematics, the articles in this publication are addressed more directly to real world problems. The appropriateness of models for certain types of problems are examined in more detail, the reasons for examining particular models are given more emphasis. In general, it might be said that the practitioners of management science are concerned with the application of operations research methodology to real world problems, while operations researchers are concerned with the development of or improvement of the methodology.

Systems analysis, as used in the defense industry, is almost completely problem oriented. E. S. Quade of the Rand Corporation defines systems analysis as:

> ". . . inquiry to aid a decision maker choose a course of action by systematically investigating his proper objectives, comparing quantitatively where possible the costs, effectiveness and risks associated with the alternative policies or strategies for achieving them, and formulating additional alternatives if those examined are found wanting."[12]

Dr. Alain Enthoven, Assistant Secretary of Defense (Systems Analysis), differentiates between operations research and systems analysis in terms of the scope of the problem. Operations research, he describes as "optimization in the small" while systems analysis is "optimization in the large."[13]

It is apparent that all of these activities can enhance the manager's decision-making ability. Many of the lower level managerial decisions, such as inventory control or office management can be formulated in such a way that operations research methodology can be applied directly. Other problems, such as those met at the higher levels of Government are difficult, if not impossible, to formulate so to apply such methodology, but can be treated from the point of view of the systems analyst. Other managerial decision problems lie in the spectrum in between and are appropriate for quantitative analysis of some form.

What these various approaches have in common, and what is most relevant to management decision making, is: (1) a sensible approach to decision problems; (2) the use of a formal analytical framework; (3) the explicit statement of the criterion of choice or goals involved; and (4) a systematic comparison of the alternatives and a methodology for dealing with the risks and uncertainties always involved in such problems. The use of a formal analytical structure requires that one look very carefully at the nature of the decision problem. Explicit statements must be made about the relationships which exist (or are believed to exist) among the variables involved. One must differentiate between those variables over which he has control and those which are functions of forces external to his control. One of the most useful results of such structuring is that it not only requires the decision maker to state what is known about the problem, but it also requires him *to recognize what he does not know about it.*

An Example of Quantitative Analysis.

Consider, for example, the problem of deciding whether the Air Force should go ahead with plans for the development and production of a new transport aircraft, one which offers a distinct advantage over the presently used aircraft in terms of speed, payload or some other operating advantage. To arrive at a sensible answer to this problem, the decision maker must obtain information about a multitude of relevant factors and determine their proper bearing on the decision. Several significant questions are posed: How will the transport be utilized? What would be the added transport capability resulting from the addition of such an aircraft to the transport fleet? What will be the impact on costs in the long run of the alternatives of developing or not developing the proposed aircraft? When will this proposed aircraft be available, and what is the expected airlift requirement for the same period? These and many other pertinent factors which have a bearing on the problem are obviously not independent of one another, nor do they deserve equal consideration. The variables over which the decision maker has control, the specification for the aircraft design, the operating and maintenance policies, the number to be purchased, etc., all must be considered in their many combinations simultaneously with the possible values of the variables over which the decision maker has neither control nor exact knowledge. The actual requirements for airlift which will exist in the future, the technological bottlenecks or breakthroughs which may occur, the costs which will accrue and many other considerations complicate the decision maker's task. Obviously, the relationship among these variables and the goals or objectives sought by the addition of the proposed transport aircraft to the fleet must be determined or estimated.

Before the structure can be defined the decision maker must look carefully at the goals or objectives he is seeking so as to determine a criterion which will allow him to select the best alternative. It is quite important that the criterion problem be looked at as a separate item in the decision process. In the first place, the establishment of a criterion involves value judgments, i.e., the determination of the relative worth of the various outcomes. It is difficult, to separate value judgments necessary for the establishment of criteria from those judgments which relate to the prediction of the future consequences of alternative courses of action.* The former involves one's value system, his likes and dislikes, or his interpretation of the likes and dislikes of the American people. The latter involves only an objective estimate of future events. Moreover, it is difficult to distinguish between personal goals and organizational or social goals, both of which influence value judgments, even when the structure of the problem forces explicit consideration of the criterion problem separate from the prediction problem. It is nearly impossible for one to make such distinctions when this aspect of the problem is not dealt with explicitly.

Finally, the criteria or goals used in the decision-making process are the crucial links which relate the decisions made at one level in an organization to the remainder of the organization. The goals or criteria utilized by the Air Force in its decision-making process must be compatible with, and support the goals of, the Department of Defense and the entire Government. In other words, the criteria for decision must be such that it measures the contribution of the alternatives to our national goals; this is indeed a most difficult task. Involved are questions of utility, suboptimization, measures of effectiveness and cost. Explicit treatment of this aspect of the problem is essential to rational decision making.

The question of criteria in our transport aircraft example is relatively simple when compared with the same aspect of decision problems relating to tactical aircraft or infantry weapons. The contribution made by transport aircraft can be measured in terms of quantity of payload and rate of delivery. Fortunately, these quan-

[12] *Quade, E. S., "Analysis for Military Decisions," R-387-PR, Nov. 1964, The Rand Corporation, p. 4.*

[13] *Enthoven, Alain, "Systems Analysis and the Navy,"* Naval Review, *1965.*

** Note: A value judgment in this example would be an estimate of the worth of having the additional capability of the proposed aircraft. A prediction judgment would estimate the way such an aircraft would perform in an emergency.*

tities can be related to a military requirement and comparisons can be made between a complete delivery system (ships, aircraft, prepositioned stocks) which contain this transport aircraft and the complete delivery systems which do not contain this aircraft. If we expect to accomplish the same mission in either case, an obvious criterion is the delivery system which costs the least. (It should be emphasized that this choice of criterion does not imply that we are looking for the least cost delivery system; we are looking for the least cost delivery system *which will perform the missions assigned.*)

With criteria established, one can proceed to structure the problem in a way which will allow for the comparison of the various alternatives. In our transport example, the alternatives to be compared are a number of delivery systems composed of different quantities of ships, aircraft, prepositioned stock, both with and without the proposed aircraft. The calculation of the number of each component of the sytem required to do the job and the cost of such an alternative requires a considerable amount of work. One advantage of having the decision problem formally structured is that these calculations can be set up as routines; consequently, computers can be utilized to perform these menial tasks. Another advantage is that such a formal structure allows one to observe the general form of the problem and, perhaps, bring to bear some of the basic mathematical theorems and greatly simplify the comparison of alternatives. Linear programming can be utilized to examine an infinite number of alternatives and select from them one which meets the basic criterion, provided, of course, that the problem can be structured as a series of linear expressions. It should be noted, in view of some of the criticisms of quantitative management, that it is in this area of comparing multiple alternatives that mathematical methods and computers make their greatest direct contribution to the decision maker. It is apparent that when used in this way computers and mathematical techniques are only tools of the trade, not the major portion of the decision process. The really significant portion of the decision process is that of selecting the variables and relationships involved, and the structuring of the problem, the selection of a criterion and, of most importance, the handling of the risks and uncertainties involved. This approach to decision making would hardly be feasible without the availability of computers and mathematical techniques which allow for the detailed comparison of many alternatives.

The Role of Uncertainty.

Probably the most important aspect of this approach to decision making is that it emphasizes the careful consideration of the uncertainties and unknowns involved in the problem, uncertainties which are inherent in any decision problem. By the very nature of decisions, the decision maker is trying to control or manipulate the future, and his decision is based on predictions about the future consequences of several courses of action. To fail to recognize this fact and to act as if one could predict the future with accuracy would be foolish. On the other hand, one can point out that the use of analysis depends entirely upon assumptions about the future and the results of the analysis can be no better than the set of assumptions upon which it is based. This, too, is true and it leaves the decision maker in a quandary. He needs to make a set of assumptions in order to apply this approach; yet he can't possibly make the correct ones. It is in this regard that the use of the analytical approach is so valuable.

Because he is working with an analytical structure, the decision maker can test the sensitivity of his decision to changes in assumption. Suppose, for example, that in our analysis concerning the proposed transport aircraft, we are not able to determine, with any degree of certainty, the quantity and rate of delivery which wil' be required in a situation in which the transport fleet is to be utilized. It is very likely that this will indeed be the case. The amount of material delivered depends upon the type of military operation being supported, the location of the support required, the distance involved, the tactics employed, etc. The analyst can make comparisons at a number of specified loads and delivery schedules for a number of likely scenarios.[14] If it turns out that the proposed transport is a member of the most economical transport system for each of these comparisons, he can be fairly confident that the decision to go ahead with the program is not sensitive to the mission. If, on the other hand, the proposed aircraft was included in the most economical transport system for only a few of such comparisons, he would know that his decision was sensitive to variations in mission. In such cases, he could either expend effort attempting to determine with a higher degree of certainty the missions requirements, or he could examine the characteristics of the proposed aircraft to see if one with more favorable characteristics might be feasible. Similar sensitivity analysis can be conducted to determine to which of the other areas of uncertainty the decision is sensitive.

The Universal Requirement for Judgment.

The use of this approach to decision making does not, of course, provide ready made answers to the decision maker. Even with sensitivity analysis many uncertainties will exist which have not been fully resolved. There are always some aspects of decision problems which cannot be formally incorporated into the analytical framework. Nor is there any completely satisfactory measure of effectiveness for making comparisons among the alternatives. However, the use of an analysis provides a great deal of insight into the nature of the decision problem. It focuses attention on the important variables and identifies the areas where subjective judgement is required. It avoids the mixing of relevant and irrelevant information and tends to reduce the amount of emotionalism involved in such decisions.

Subjective judgments must still be made, but this approach pinpoints the factors to be judged and clearly states what judgments were utilized in the analysis—leaving them to be challenged and defended if need be. The structure of the problem allows an individual who is not an expert in all aspects of the problem to inject his judgment in those areas where his expertise is valid without attempting to relate to the other factors about which his knowledge is limited. It allows a specialist, for example, to make judgments based on this background in his specialty without becoming involved in questions of technology, cost, or politics. He is not required to make recommendations as to whether a certain weapon should be bought or not (which implies a decision on his part) but to forecast the operational consequences of the use of such a weapon.

This discussion has dwelled on the application of quantitative analysis for decisions at the higher levels of management, but the same approach can be applied to a lower level decision problem as well. It may be that there are fewer uncertainties and a less elaborate analysis may be sufficient. In some cases the problem may be so simple that the decision maker can conduct an adequate analysis without resorting to pencil and paper. Or perhaps the consequences of choosing a non-optional alternative are not serious enough to warrant a comprehensive analysis, and a decision based on past experience alone may be entirely adequate. But when the consequences are serious and the problem complex, it behooves a good manager to utilize the power of analysis.

Criticisms and Misconceptions of Quantitative Analysis.

Invariably in a discussion of this approach to the decision-making process of management a number of criticisms arise. This technique, like any other, has its shortcomings but many of these criticisms are based on misconceptions.

First is the thought that the advocates of quantitative management treat management as if it were a mathematical model waiting only for the mathematically oriented manager

[14] *Scenario is defined as an outline plan of the actions to be undertaken during a projected exercise or maneuver.*

to solve a set of equations or to perform some esoteric algebraic operation. Quantitative management is concerned almost entirely with decision making; it hardly pretends to address itself to the execution phases of management, which are clearly a significant proportion of the manager's task. Moreover, the mathematics involved are used primarily as tools of the analyst. In many cases, little or no mathematics beyond simple arithmetic or elementary algebra is required for analysis; emphasis is on the proper structuring of the problem for analysis. A solid background in mathematics can be extremely valuable in even simple analysis, and may lead to the application of some valuable mathematical technique or principle; however, the manager need not be a mathematician.

Another misconception about the use of quantitative analysis in managerial decision making is that it does not allow for judgment. This criticism has been particularly strong in regard to the use of systems analysis for decision making by the Secretary of Defense. The claim is that analysis has replaced military judgment in the formulation of our defense posture. If military judgment has been excluded from these matters, it is not because this approach does not provide for the inclusion of such judgment. Indeed, analysis not only requires that military judgment be exercised, but sharpens the areas in which such judgment must be made. It tends to separate those factors in a decision problem in such a way that judgments can be made separately, by experts, rather than requiring an expert in one field to judge economic, military, political and other factors simultaneously. It also helps to separate value judgments from those judgments related to the forecasting of the consequences of particular courses of action. Moreover, it tends to reduce the area in which subjective judgments are required and to identify clearly and expose such judgments for criticism and debate. A procedure which either ignores the requirement for such judgments, or allows the analyst to make and bury such judgments would clearly be a dangerous one. That such a procedure is suggested by the use of quantative analysis is clearly a misconception.

Another criticism based on misconception is that quantitative analysis results in turning problems over to electronic computers for solution. Such ideas not only indicate a misunderstanding of quantitative analysis but of computers as well. The role of the computer in quantitative analysis is an important one. The main use of the computer is for performing routine calculations which would require a great deal of manpower and time if the computer were not available. The fact that computers can be utilized for this purpose makes it economical for many alternatives to be explored in depth and, consequently, for the analysis to be much more complete than would otherwise be possible. Viewing the computer as a decision maker, however, is completely absurd. Computers can only perform routine calculations and then only after a programmer has carefully provided instructions on every minute detail of the calculation procedure. The extent of their decision-making capability is to distinguish between signs (+, −, 0) and perform some clearly defined routine as the result of each. More important to this argument, however, is the fact that the essential portion of this approach is the structuring of the decision problem and in the interpretation of results, neither of which involve the use of computers. The relative importance of the computer in quantitative analysis is quite small.

One other aspect of quantitative analysis for decision making which appears to be generally misunderstood is the use of cost effectiveness studies in the Department of Defense. There is a tendency to equate cost effectiveness with a decision procedure which selects the cheapest system. The truth of the matter is that cost effectivness studies, a particular form of quantitative analysis used throughout the Department of Defense, does not mean that at all. It means taking the least cost alternative *of those alternatives which are equally effective.* There is quite a difference in the two statements, and one would have great difficulty in arguing against the latter. This should not be interpreted as an over emphasis on cost, or as assigning first priority to cost and second to effectiveness, but of balancing cost with effectiveness, at least conceptually. It merely says what our military and civilian leaders have said all along, "Let's do our job, but let's do it at the lowest cost." The difference is that quantitative analysis allows us to attempt to find the lowest cost way of doing the job. Without such analysis, these words are without meaning.

Demands on the Total Manager.

The job that we have outlined here for the *total manager* is not an easy one. We are insisting that he not only be an expert in traditional management practices, but also that he have some competency in quantitative analysis. He cannot afford to view qualitative vs. quantitative as two distinct types of management but must accept them as segments of the whole which complement each other. Only a management philosophy developed on this basis is adequate for today's Defense-industrial management task.

Management relationships and problems are changing as new theories and techniques are formulated. Principles of management established a few years ago may become inadequate as the environment changes. No doubt schools of management will continue to evolve as we become knowledgeable about the structure and dynamics of our industrial and Defense society. The manager must maintain his pragmatism and utilize the contributions of all the schools in order to support the making and execution of decisions in an environment of high risk and uncertainty. His management philosophy must change with the changing patterns in management.

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shots up to date, ready to respond to any emergency. Within a short time, a GEEIA team, or combination of teams tailored to the particular job, can be airborne enroute to the trouble spot. TRUST can put the teams on site, ready to work, soon after the call for help.

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"Why Vietnam" Film Available

"Why Vietnam," a 32-minute black and white motion picture which outlines U.S. policy in that country, is now available for public non-profit showing.

The 16mm film opens with President Johnson's news conference statement to the nation of July 28, 1965, and elaborates on the basic points he discussed. Scenes from the struggle in Vietnam illustrate the various points made by the President.

Secretary of State Dean Rusk and Defense Secretary Robert S. McNamara are also featured in the film, which was produced by Armed Forces Information and Education, Department of Defense.

Prints of "Why Vietnam" can be borrowed by civilian organizations free of charge. Requests should be sent to the Army Audio-Visual Support Center supporting the area in which you are located (check list below).

Prints may also be purchased from DuArt Film Laboratories, Inc., 245 West 55th Street, New York, N.Y.

Army Audio-Visual Support Centers from which the film can be borrowed are:

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Fort Richardson, Alaska
863–8209
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USARPAC Army Audio-Visual Support Center
Fort Shafter, Hawaii
863–203
Area Supported: Hawaii

U.S. Army Audio-Visual Support Center
Room 5A1072
The Pentagon
Washington, D.C.
(Area Code 202) OXford 55320
Area Supported: Washington, D.C.

Defense Speakers

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grams of the Air Force Systems and Logistics Commands:
Speakers: (At all five cities)
Hon. Robert H. Charles, Asst. Secretary of the Air Force (Installations & Logistics).
Lt. Gen. W. A. Davis, USAF, Vice-Commander, Air Force Systems Command (AFSC).
Maj. Gen. Marvin C. Demler, USAF, Commander, Research & Technology Div. (AFSC).
Maj. Gen. Jack J. Catton, USAF, Dir., Operational Requirements & Development Plans, Hq., USAF.
Maj. Gen. Gerald F. Keeling, USAF, DCS/Procurement & Production (AFSC).
Brig. Gen. Robert H. McCutcheon, USAF, Dir., Procurement and Production, Air Force Logistics Command.

Procurement Conferences Set for Texas & Iowa

Two procurement information conferences have been slated for February in El Paso, Tex., and Council Bluffs, Iowa, to aid industry development.

A Procurement Clinic, sponsored by the El Paso Chamber of Commerce, the El Paso Board of Development and Industrial Development Corporation of El Paso, will be held Feb. 10.

A Procurement and Industrial Development Conference will also be held Feb. 24 in Council Bluffs, Iowa.

For information on the two conferences contact Donald Holinberg, Executive Vice President, Chamber of Commerce, P.O. Box 682, El Paso, Tex., or William Keister, Box H, Council Bluffs, Iowa.

Springfield Armory to be Phased Out

Defense Secretary McNamara has directed that all activities at the Springfield Armory in Massachusetts be phased out over the next two and a half years in accordance with the original decision to close down the activity announced last year.

The reaffirmation of the decision follows a comprehensive study by the Booz, Alen & Hamilton firm of management consultants which concluded that the long-range retention of the Springfield Armory for the acquisition of small arms and weapons systems is neither necessary nor desirable.

The study further stated the Armory's manufacturing capacity and development capability are not needed.

As in the case in similar inactivations of surplus facilities, all career employees whose jobs are eliminated will be offered another job opportunity. If the new job requires a move to another location, the moving expenses involved will be borne by the Government. The services of the DOD Office of Economic Adjustment will be made available to the community, if requested.

Executive Secretary of DIAC Appointed

Clyde Bothmer, former Director of the National Aeronautics and Space Administration's Office of Industrial Affairs, has been selected as Executive Secretary of the Defense Industry Advisory Council.

Bothmer succeeds Samuel W. Crosby, who resigned from the position last September.

The council was established in May 1962, and has provided an important forum for discussions by the Secretary of Defense and his principal management assistants with leaders selected from business and industry.

Amphibious Warfare Classified Briefing Set

Amphibious warfare will be the subject of a classified briefing for industry sponsored by the Navy, Marine Corps and Electronic Industries Association, March 1–3, 1965.

The meeting will be held at the Naval Amphibious Base, Coronado, San Diego, Calif. For program security forms and pre-registration information contact Mr. John Sodolski, Electronic Industries Association, 2001 Eye St., N.W., Washington, D.C. 20006, (Area Code 202) 659–2200.

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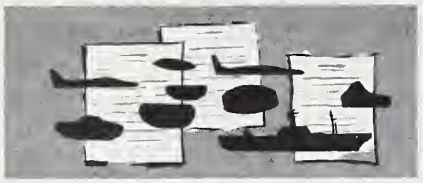

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of December 1965:

DEFENSE SUPPLY AGENCY

2—**Standard Oil Co. of Calif.,** San Francisco. $1,850,000. 13,088,100 gallons of RP–1 rocket fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Blue Star Foods, Inc.,** Council Bluffs, Iowa. $1,952,252. 3,218,080 cans of hamburger patties. Defense Personnel Support Center, Philadelphia.

3—**Delta Petroleum Co.,** New Orleans. $2,710,-792. 6,318,372 gallons of lubricating oil for aircraft engines. Defense Fuel Supply Center, Alexandria, Va.

7—**Pacific Mills Division of Burlington Industries** Halifax, Va. $1,983,400. 470,000 yards of wool gabardine cloth. Raeford, N.C. and Clarksville, Va. Defense Personnel Support Center, Philadelphia.

—**J. P. Stevens, Inc.,** New York City. $1,905,260. 436,000 yards of wool gabardine cloth. Sumpter and Wallace, S.C. Defense Personnel Support Center, Philadelphia.

8—**Univac Division of Sperry Rand Corp.,** Washington, D.C. $1,571,760. Data proceessing equipment. Washington, D.C. Defense Construction Supply Center, Columbus, Ohio.

—**Southern Athletic Co.,** Knoxville, Tenn. $1,376,320. 147,200 men's light-weight raincoats. Knoxville. Defense Personnel Support Center, Philadelphia.

13—**Coastal States Petrochemical Co.,** Houston, Tex. $4,854,234. 1,100,000 barrels of type I, motor gasoline (86/9 octane). Defense Fuel Supply Center, Alexandria, Va.

14—**Southern Athletic Co.,** Knoxville, Tenn. $1,586,953. 251,040 men's nylon sateen field coats. Knoxville. Defense Personnel Support Center, Philadelphia.

—**Oscar Mayer and Co.,** Madison, Wis. $1,713,262. 973,500 pounds of canned sliced bacon. Madison. Defense Personnel Support Center, Philadelphia.

15—**DeRossi & Son Co.,** Vineland, N.J. $1,987,-500. 150,000 men's wool serge coats. Vineland. Defense Personnel Support Center, Philadelphia.

—**Tursini & Co.,** Vineland, N.J. $1,044,000. 75,000 men's wool serge coats. Vineland. Defense Personnel Support Center, Philadelphia.

16—**Cherubino Petti & Co.,** Atlantic City, N.J. $1,783,500. 80,000 men's wool coats. Atlantic City. Defense Personnel Support Center, Philadelphia.

17—**American Oil Co.,** Chicago. $2,265,816. 500,000 barrels of octane gasoline. Defense Fuel Supply Center, Alexandria, Va.

21—**Tennessee Overall Co.,** Tullahoma, Tenn. $1,035,555. 508,500 men's cotton polyesterene twill trousers. Tullahoma. Defense Personnel Support Center, Philadelphia.

22—**A.M. Ellis Hosiery Co.,** Philadelphia. $1,155,040. 1,600,000 pairs of men's socks. Defense Personnel Support Center, Philadelphia.

23—**Ingersoll Products Division,** Borg-Warner Corp., Chicago. $1,372,000. 400,000 soldiers' steel helmets. Cbicago. Defense Personnel Support Center, Philadelphia.

—**Coastal States Petrochemical Co.,** Houston, Tex. $1,970,640. 510,000 barrels of diesel fuel. Houston. Defense Fuel Supply Center, Alexandria, Va.

27—**Bonham Mfg. Co.,** Bonham, Tex. $2,008,-195. 350,000 men's cotton poplin wind-resistant coats. Bonham. Defense Personnel Support Center, Philadelphia.

—**Supreme Mfg. Co.,** Dallas, N.C. $1,454,481. 3,071,760 men's crew-neck undershirts. Dallas. Defense Personnel Support Center, Philadelphia.

—**Southern Packaging and Storage Co.,** Greenville, Tenn. $1,310,164. 2,014,526 cases of individual combat meals. Greenville, Tenn. and Mullins S.C. Defense Personnel Support Center (Chicago Subsistence Regional Office).

29—**Addison Shoe Corp.,** Wynne, Ark. $1,835,-000. 250,000 pairs of combat boots. Wynne. Defense Personnel Support Center, Philadelphia.

—**H. H. Brown Shoe Co.,** Worcester, Mass. $1,089,200 140,000 pairs of combat boots. Worcester. Defense Personnel Support Center, Philadelphia.

—**Safety First Shoe Co.,** Nashville, Tenn. $1,648,123. 233,280 pairs of combat boots. Huntsville, Ala. Defense Personnel Support Center, Pbiladelpbia.

—**Sportwelt Shoe Co.,** Nashua, N.H. $1,191,000. 150,000 pairs of combat boots. Newport, N.H. Defense Personnel Support Center, Philadelphia.

—**Kaiser Steel Corp.,** Fabricating Div., Fontana, Calif., $10,551,940. 46,000 landing mat sets. Fontana. Defense Construction Supply Center, Columbus, Ohio.

—**Republic Steel Corp.,** Manufacturing Div., Youngstown, Obio. $5,984,160. 26,000 landing mat sets. Youngstown. Defense Construction Supply Center, Columbus, Ohio.

—**J. B. Roerig and Co.,** Division of Charles Pfizer and Co., New York City. $1,244,973. 529,776 bottles of tetracycline hydrochloride tablets. New York City. Defense Personnel Support Center, Philadelphia.

ARMY

1—**Research Analysis Corp.,** McLean, Va. $1,240,000. Military operations research. McLean. Defense Supply Service, Washington, D.C.

—**Laboratory for Electronics, Inc.,** Boston, Mass. $3,194,000. Airborne receivers for UH–1 and CH–47 helicopters. Danvers, Mass. Army Electronics Command, Pbiladelphia.

—**Wilkinson Mfg. Co.,** Fort Calhoun, Neb. $1,842,800. Ordnance items. Fort Calhoun. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**REDM,** Wayne, N.J. $1,870,000. Ordnance. Wayne. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**I.D. Precision Components Corp.,** Jamaica, N.Y. $1,768,000. Ordnance items. Gadsden, Ala. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Action Mfg. Co.,** Philadelphia. $1,883,600. Ordnance. Philadelphia. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Columbus Milpar,** Columbus, Obio. $1,800,-300. Ordnance items. Columbus. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**General Tire & Rubber Co.,** Akron, Ohio. $1,112,788. Ordnance items. Akron. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**General Instrument Corp.,** Chicopee, Mass. $2,367,052. Ordnance items. Joliet, Ill. and Chicopee. Ammunition Procurement & Supply Agency, Joliet, Ill.

2—**W. R. Grimshaw Construction Co.,** Houston, Tex. $1,772,000 (NASA funds). Construction of tbe technical services facility at the Manned Spacecraft Center, Clearlake, Tex. Engineer Dist., Fort Worth, Tex.

3—**Mine Safety Appliances Co.,** Pittsburgh, Pa. $1,200,807. Items for chemical agent detector kits, refill kits and clips. Pittsburgh. Edgewood Arsenal, Md.

—**Cooperweld Steel Co.,** Glassport, Pa. $6,-742,270. Wire mesh fabric and forms for the Mississippi River and Tributaries Project. Glassport. Engineer Dist., Memphis, Tenn.

—**Magnavox Co.,** Urbana, Ill. $5,641,432. Gun direction computers. Urbana. Frankford Arsenal, Philadelphia.

—**International Harvester Co.,** Washington, D.C. $1,758,751. Tractor trucks. Fort Wayne, Ind. Army Tank Automotive Center, Warren, Micb.

6—**Troup Bros.,** Coral Cables, Fla. $1,906,830. Work on Central and Soutbern Florida Flood Control Project, Dade County, Fla. Engineer Dist., Jacksonville, Fla.

—**Arundel Corp.,** Baltimore, Md. $1,814,258. Work on Central and Southern Florida Flood Control Project in Okeecbobee and Martin counties. Engineer Dist., Jacksonville, Fla.

—**University of Michigan,** Ann Arbor, Mich. $1,320,000. Design, development and test computer program services. Ann Arbor. Defense Supply Service, Washington, D.C.

—**Douglas Aircraft,** Santa Monica, Calif. $2,450,000. Work on a classified research project. Santa Monica. Army Missile Command, Huntsville, Ala.

—**SCM Corp.,** Deerfield, Ill. $1,858,097. Teletypewriter sets and reperforator-transmitter teletypewriters. Deerfield. Army Electronics Command, Philadelphia.

7—**Colt, Inc.,** Hartford, Conn. $5,750,000. 5.56mm rifles. Hartford. Army Weapons Command, Rock Island, Ill.

—**R. G. LeTourneau, Inc.,** Longview, Tex. $1,198,420. Ordnance items. Longview. Ammunition Procurement & Supply Agency, Joliet, Ill.

8—**Kaiser Jeep Corp.,** Toledo, Ohio. $1,957,148. 2½-ton trucks. South Bend, Ind. General Purpose Vehicle Project Manager, Warren, Mich.

—**Raytheon Co.,** Lexington, Mass. $1,600,000. Development of self-propelled HAWK modification to the HAWK missile system. Bedford, Mass. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

9—**General Motors,** Detriot, Micb. $1,952,809. 8-cylinder diesel engines. Detriot. Army Tank Automotive Center, Warren, Micb.

—**Harrington & Richardson, Inc.,** Worcester, Mass. $1,345,733. 7.62mm gun barrels and two sets of final inspection equipment. Worcester. Army Weapons Command, Rock Island, Ill.

—**Delong Corp.,** New York City. $9,000,000. Delong pier approacb and pier units with accessory equipment. New York City. Army Mobility Equipment Center, St. Louis.

10—**Standard Products Co.,** Cleveland, Ohio. $5,105,050. Rubber track shoe assemblies for M113 vehicles. Port Clinton, Ohio. Army Tank Automotive Center, Warren, Mich.

—**FMC Corp.,** Charleston, W. Va. $4,302,241. Rubber track shoe assemblies for M113 vehicles. Charleston. Army Tank Automotive Center, Warren, Micb.

—**Firestone Tire & Rubber Co.,** Akron, Ohio. $3,056,505. Rubber track sboe assemblies for M113 vehicles. Noblesville, Ind. Army Tank Automotive Center, Warren, Mich.

—**Cook Construction Co.,** Jackson, Miss. $1,109,673. Work on the Jackson and East Jackson, Mississippi, Local Flood Protection Project. Engineer Dist., Mobile, Ala.

—**Stewart-Erickson Co.,** Seattle, Wash. $4,-770,807. Work on the Downtown Urban Renewal Project, Anchorage, Alaska. Engineer Dist., Anchorage, Alaska.

—**Hercules Construction Co.,** Overland, Mo. $1,551,991. Work on St. Louis, Mo., Flood Protection Project. Engineer Dist., St. Louis.

—**Raven Industries,** Sioux Falls, S.D. $1,295,-000. Ordnance items. Sioux Falls. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Olin Mathieson Chemical Corp.,** E. Alton, Ill. $1,866,712. $1,853,743. Propellants for 20 and 7.62mm cartridges. E. Alton. Frankford Arsenal, Pbiladelphia.

13—**General Motors,** Detroit. $1,522,679. Eight-cylinder engines for the self-propelled 8-inch howitzer, the self-propelled 175mm gun and the recovery vehicle. Detroit. Army Tank Automotive Center, Warren, Micb.

—**Electronic Assistance Corp.,** Redbank, N.J. $5,223,276. Radio receivers. Redbank. Army Electronics Command, Philadelphia.

—**Terminal Construction Corp.**, Wood-Ridge, N.J. $3,590,000. Construction of troop housing and supporting facilities at Fort Dix, N.J. Engineer Dist., New York City.

—**J.J. Fritch & Co.**, Dallas Tex. $3,100,640. Construction of five tactical equipment shops, and facilities, at Fort Hood, Tex. Engineer Dist., Fort Worth, Tex.

—**Radiation, Inc.**, Melbourne, Fla. $1,993,427. Satellite communications terminals (AN/TSC–54) MARK IV. Melbourne. Army Electronics Command, Fort Monmouth, N.J.

—**R. G. LeTourneau, Inc.**, Longview, Tex. $3,579,740. Ordnance items. Longview. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Honeywell, Inc.**, Hopkins, Minn. $2,018,-608. Ordnance items. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.

15—**Bendix Corp.**, Teterboro, N.J. $10,048,070. Guidance & control components for the PERSHING missile system. Teterboro. Army Missile Command, Huntsville, Ala.

—**General Motors Corp.**, Allison Div., Warren, Mich. $17,016,613. Continuation of Phase III, US–FRG Main Battle Tank Development Program. Milwaukee, Wis.; Detroit, Mich. and Warren. Army Tank Automobile Center, Warren, Mich.

—**Bendix Corp.**, York, Pa. $7,202,975. Ordnance items. York. Harry Diamond Laboratories, Washington, D.C.

—**General Motors Corp.**, Detroit. $3,258,813. Six-cylinder diesel engines. Detroit. Army Tank Automotive Center, Warren, Mich.

16—**Hercules Powder Co.**, Wilmington, Del. $1,999,107. Propellants and operations and maintenance. Lawrence, Kan. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Raytheon Co.**, Lexington, Mass. $1,073,272. HAWK field service documentation during FY 66. Andover, Mass. Army Missile Command, Huntsville, Ala.

—**Berry Construction Co.**, Decatur, Ill. $1,-090,480. Work on Shelbyville, Reservoir, Ill., Project. Engineer Dist., St. Louis.

17—**Firestone Tire & Rubber Co.**, Akron, Ohio. $4,537,239. Tires for trucks and trailers. Decatur, Ill. and Pottstown, Pa. Army Tank Automobile Center, Warren, Mich.

—**Mansfield Tire & Rubber Co.**, Mansfield, Ohio. $1,608,887. Tires for ¾-ton trucks and trailers. Mansfield. Army Tank Automotive Center, Warren, Mich.

—**Zenith Radio Corp.**, Chicago. $2,090,200. Sensing element proximity fuzes. Chicago. Picatinny Arsenal, Dover, N.J.

—**General Motors, Diesel Engine Div.**, Detroit. $1,071,000. 120 multi-purpose 100 KW generator sets. Detroit. Army Mobility Equipment Center, St. Louis.

20—**Raytheon Co.**, Lexington, Mass. $1,155,530. Selected items of ground support equipment for the HAWK missile system. Waltham and Andover, Mass. Army Missile Command, Huntsville, Ala.

—**Emerson Electric Co.**, St. Louis. $2,627,-000. Helicopter ordnance items. St. Louis. Army Weapons Command, Rock Island, Ill.

—**Harvey Aluminum Co.**, Torrance, Calif. $1,729,543. Fuzes and fuze spare parts. Torrance. Frankford Arsenal, Philadelphia.

21—**General Electric**, Nashville, Tenn. $2,615,-315. Design, manufacture, delivery and installation of 3 generators for the Cordell Hull Dam. Design & manufacture will be done at Schenectady, N.Y. and Waynesboro, Va. Delivery and Installation will be to the Cumberland River Project, Tenn. Engineer Dist., Nashville, Tenn.

—**Colt's Inc.**, Hartford, Conn. $1,855,550. Repair parts for M16 and XM16E1 5.56mm rifles. Hartford Army Weapons Command, Rock Island, Ill.

—**Bell Helicopter Co.**, Division of Bell Aerospace Corp., Fort Worth, Tex. $1,372,091 and $4,709,781. Rotor blade assemblies for UH–1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis.

22—**Kisco Co.**, St. Louis. $6,647,617. 105mm cartridge cases. St. Louis. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Union Carbide Corp.**, Consumer Products Div., New York City. $1,037,415. Dry cell batteries and tactical radio sets. New York City. Army Electronics Command, Philadelphia.

—**Baifield Industries**, Carrollton, Tex. $1,-239,000. 600 half-ton utility trucks. Carrollton. Army Tank Automotive Center, Warren, Mich.

—**Continental Motors**, Muskegon, Mich. $4,-119,220. Engine assembly and connecting parts for transmissions used on the M60A1 tank. Muskegon. Army Tank Automotive Center, Warren, Mich.

—**Bell Helicopter Co.**, Division of Bell Aerospace Corp., Fort Worth, Tex. $1,276,268. Gear box assemblies for UH–1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis.

23—**Associated Spring Corp.**, Wallace Barnes Div., Bristol, Conn. $1,318,475. 20mm link cartridge belts. Frankford Arsenal, Philadelphia.

—**Mohawk Rubber Co.**, Akron, Ohio. $1,653,-200. 2½-ton truck tires. Akron. Army Tank Automotive Center, Warren, Mich.

—**Firestone Tire & Rubber Co.**, Akron, Ohio. $2,128,320. 2½-ton truck tires. Akron. Army Tank Automotive Center, Warren, Mich.

—**Liles Construction Co.**, Montgomery, Ala. $1,759,040. Construction of airmen's dormitories and dining hall at MacDill AFB, Fla. Engineer Dist., Jacksonville, Fla.

—**Hughes Tool Co.**, Aircraft Div., Culver City, Calif. $2,859,280. TH–55A (Primary Trainer) helicopters. Culver City. Army Aviation Materiel Command, St. Louis.

—**KDI Corp.**, Cincinnati, Ohio. $1,195,273. M423 fuze metal parts. Cincinnati. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Gibbs Mfg. Co.**, Janesville, Wis. $1,147,-838. M423 fuze metal parts. Janesville. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**AVCO Corp.**, Ordnance Div., Richmond, Ind. $1,210,487. M423 fuze metal parts. Richmond. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Hamilton Watch Co.**, Lancaster, Pa. $1,-241,813. M423 fuze metal parts. Lancaster. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**General Time Corp.**, Westclox Div., La Salle, Ill. $1,315,426. M423 fuze metal parts. La Salle. Ammunition Procurement and Supply Agency, Joliet, Ill.

27—**Western Electric**. New York City. $92,-814,791. NIKE-X research and development. Burlington, N.C.; Winston-Salem, N.C.; Allentown, Pa.; Greensboro, N.C.; and Laureldale, Pa. NIKE-X Project Officer, Redstone Arsenal, Huntsville, Ala.

—**Bell Helicopter Division of Bell Aerospace Corp.**, Fort Worth, Tex. $3,550,372 and $1,825,691. Rotary wing blades for UH–1 helicopters and tail boom assemblies for UH–1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis, Mo.

—**Honeywell, Inc.**, Hopkins, Minn. $2,289,-962. M551 fuze metal parts. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.

28—**Kaiser Aluminum & Chemical Sales Div.**, Oakland, Calif. $25,084,498. MX–19 aluminum honeycomb core airplane landing mats. Berkeley and San Diego, Calif. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

—**Ford Motor Co.**, Dearborn, Mich. $2,377,-004. Carry-all, cargo and panel trucks. Dearborn. Army Tank Automotive Center, Warren, Mich.

—**Raymond Engineering Laboratories**, Middletown, Conn. $1,002,131. M414 fuze parts. Middletown. Harry Diamond Laboratories, Washington, D.C.

29—**Parsons Mfg & Stamping Co.**, Cordova, Tenn. $1,226,890. Ordnance items. Cordova. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**American Fabricated Products Co.**, Indianapolis. $1,214,329. Ordnance items. Indianapolis. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Raytheon Co.**, Lexington, Mass. $4,653,097. Maintenance and modification of special tooling and test equipment to support the HAWK missile system. Lexington. Army Missile Command, Huntsville, Ala.

—**Raytheon Co.**, Lexington, Mass. $4,663,188. FY 1966 industrial engineering services for the HAWK missile system. Lexington. Army Missile Command, Huntsville, Ala.

—**FMC Corp.**, San Jose, Calif. $1,444,452. Ordnance items. San Jose. Picatinny Arsenal, Dover, N.J.

—**Honeywell, Inc.**, Hopkins, Minn. $1,924,-000. Research and development of classified ammunition. Hopkins. Picatinny Arsenal, Dover, N.J.

—**Johnson Furnace Co.**, Bellevue, Ohio. $1,-438,019. ¼-ton trailers and trailer chassis. Bellevue. Army Tank Automotive Center, Warren, Mich.

—**General Motors**, Chevrolet Motor Div., Detroit. $11,531,154. Various types of commercial trucks. Detroit. Army Tank Automotive Center, Warren, Mich.

—**Wagner Electric Co.**, St. Louis. $2,125,240. 4.2-inch mortar projectile parts. St. Louis. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Kennedy Van Saun Corp.**, Danville, Pa. $1,999,280. 4.2-inch mortar projectile parts. Danville. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**International Harvester Co.**, Washington, D.C. $1,915,642. Various model trucks. Fort Wayne, Ind. Army Tank Automotive Center, Warren, Mich.

30—**Bell Aerosystems Co.**, Division of Bell Aerospace Corp., Buffalo, N.Y. $1,997,060. Exploratory development of an individual lift device system. Buffalo, N.Y. and Walled Lake, Mich. Army Aviaion Material Command, St. Louis.

—**General Electric Co., Missile & Armament Dept.**, Burlington, Vt. $3,734,586. Ordnance items. Burlington. Army Weapons Command, Rock Island, Ill.

—**Martin Zachry Constructors**, Honolulu, Hawaii. $3,394,665. Construction of NIKE-ZEUS, NIKE-X and PRESS (Pacific Range Electromagnetic Signature Study) facilities at Kwajalein Atoll, Marshall Islands. Engineer Dist., Honolulu.

—**Westrex Communications Division of Litton Systems, Inc.**, New Rochelle, N.Y. $6,926,-247. Radio transmitters and receiving equipment. Pelham Manor, N.Y. Army Electronics Command, Philadelphia.

—**Philco Corp.**, Newport Beach, Calif. $71,-393,000. FY 1966 production of the SHILLELAGH missile system. Lawndale, Calif. Army Missile Command, Huntsville, Ala.

—**Eby & Associates of Arkansas**, Wichita, Kan. $14,218,966. Work on Lock and Dam #9, Arkansas River Project. Morrilton, Ark. Engineer Dist., Little Rock, Ark.

—**Collins Radio Co.**, Dallas, Tex. $9,045,290. Long line microwave system for the Republic of Korea Army and Korean Ministry of Communications. Dallas and Richardson, Tex. Army Electronics Command, Fort Monmouth, N.J.

—**ITT Gilfillan, Inc.**, Los Angeles. $1,050,000. Ground radar sets. Los Angeles. Army Electronics Command, Fort Monmouth, N.J.

—**Philco Corp.**, Newport Beach, Calif. $3,-310,501. Adaptation of a classified quantity of the SHILLELAGH missiles to the Main Battle Tank. Newport Beach. Army Southwest Procurement Agency, Pasadena, Calif.

—**Philco Corp.**, Newport Beach, Calif. $7,-752,625. SHILLELAGH industrial engineering support. Newport Beach. Army Southwest Procurement Agency, Pasadena, Calif.

—**General Motors, Chevrolet Div.**, Detroit. $1,444,482. 4X2 school buses. Richmond, Ind. and Conway, Ark. Army Tank Automotive Center, Warren, Mich.

—**International Harvester Co.**, Washington, D.C. $3,253,390. Various sizes of tractor dump trucks. Fort Wayne, Ind. and Sprinfield, Ohio. Army Tank Automotive Center, Warren, Mich.

—**General Motors, Chevrolet Div.**, Detroit. $4,988,636. Stake and platform trucks. Baltimore, Md. and St. Louis. Army Tank Automotive Center, Warren, Mich.

—**International Harvester Co.**, Washington, D.C. $1,870,593. School buses. Richmond, Ind. Army Tank Automotive Center, Warren, Mich.

—**General Motors**, Chevrolet Div., Detroit. $5,017,492. 4-door automobile sedans. Boxwood Road, Del. Army Tank Automotive Center, Warren, Mich.

—**Pace Corp.**, Memphis, Tenn. $2,102,048. Aerial photoflash cartridges. Memphis. Army Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Amron Corp.**, Waukesha, Wis. $1,708,454. 40mm cartridge cases. Waukesha. Army Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Bulova Watch Co.**, Jackson Heights, N.Y. $1,282,088. M423 fuze metal parts. Jackson Heights. Army Ammunition Procurement & Supply Agency, Joliet, Ill.

—**AiResearch Mfg. Co.**, Division of the Garrett Corp., El Segundo, Calif. $1,377,-299. 60KW gas turbine generator sets.

El Segundo, Calif. and Phoenix, Ariz. Army Mobility Equipment Center, St. Louis.

—Eagle Engineering Mfg. Co., Louisville, Ky. $2,792,808. 3KW, 60-cycle, AC air-cooled generator sets. Louisville. Army Mobility Equipment Center, St. Louis.

NAVY

2—Farmer Tool Co., Denver, Colo. $2,701,800. Nozzle and fin assemblies for 2.75-inch rockets. Denver. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—Applied Science Industries, Falls Church, Va. $1,863,000. Nozzle and fin assemblies for 2.75-inch rockets. Falls Church. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—Muncie Gear Co., Muncie, Ind. $6,303,816. 2.75-inch rocket nozzle and fin assemblies. Muncie. Navy Ships Parts Control Center, Mechanicsburg, Pa.

3—Sperry Rand Corp., Great Neck, N.Y. $12,263,103. Prototype sonar system kits. Great Neck. Bureau of Ships.

—Admiral Corp., Chicago. $1,165,000. Classified electronics equipment. Chicago. Bureau of Ships.

—Garrett Corp., AiResearch Mfg. Co. Div., Torrance, Calif. $1,375,000. Computers for F-4B aircraft. Torrance. Navy Aviation Supply Office, Philadelphia.

6—Defoe Shipbuilding Co., Bay City, Mich. $4,182,392. Construction of a small surveying ship (AGS). Bay City. Bureau of Ships.

7—General Instruments, Inc., Hicksville, N.Y. $1,249,873. Classified electronics equipment. Hicksville. Bureau of Ships.

—Huber, Hunt and Nichols, Inc., Santa Clara, Calif. $14,059,000. Construction of a 650-bed hospital at the Naval Hospital, Oakland, Calif. Dir., Western Div., Bureau of Yards and Docks.

—Douglas Aircraft, Long Beach, Calif. $2,892,606. Countermeasure sets. Long Beach. Bureau of Naval Weapons.

—PRD Electronics, Inc., Westbury, N.Y. $1,499,000. FY 66 research & development on VAST (Versatile Avionics Shop Test Equipment). Westbury. Bureau of Weapons.

—North American Aviation, Inc., McGregor, Tex. $5,362,026. Rocket motors for Sparrow and Shrike missiles. McGregor. Bureau of Naval Weapons.

—Raytheon Co., Lexington, Mass. $3,715,636. Airborne radar sets for the Navy and Air Force. Bristol, Tenn and Waltham, Mass. Bureau of Naval Weapons.

—Western Electric Co., New York City. $1,298,010. Engineering services on the TERRIER, TARTAR and TALOS missile systems. New York City. Bureau of Naval Weapons.

8—R. D. Lambert and Sons, Norfolk, Va. $1,474,333. Construction of a technical training building at the Fleet Training Center, Norfolk, Va. Dir., Atlantic Div., Bureau of Yards and Docks.

—Texas Instruments, Inc., Dallas, Tex. $2,189,306. Classified submarine equipment. Dallas. Bureau of Ships.

—Hawaiian Dredging and Construction Co., Honolulu, Hawaii. $1,919,000. Construction of a Pacific Fleet Tactical Range at Kauai Island, Hawaii. Officer in Charge of Construction, Mid-Pacific Div., Bureau of Yards and Docks.

9—Universal Match Corp., Ferguson, Mo. $9,119,701. ASROC launchers. Ferguson. Navy Purchasing Office, Washington, D.C.

10—M.I.T., Cambridge, Mass. $3,000,000. Tactical engineering support for POLARIS guidance systems. Cambridge. Special Projects Office.

—General Precision, Inc., Binghampton, N.Y. $3,823,657. Production units of the F-4D weapon system training sets. Binghampton. Naval Training Device Center, Port Washington, N.Y.

11—Bethlehem Steel Co., San Francisco. $2,438,960. Activation of the tank landing ship USS JENNINGS COUNTY (LST-846). San Francisco. Industrial Manager, Twelfth Naval District.

—Pacific Ship Repair Co., San Francisco. $1,776,000. Activation of the tank landing ship USS HUNTERDON COUNTY (LST-838). San Francisco. Industrial Manager, Twelfth Naval District.

13—American Metal Fabricators Co., Bristol, Pa. $1,272,803. Steel pallets for bomb storing and shipping. Bristol. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—Sanders Associates, Nashua, N.H. $3,352,724. Evaluation and repair of government owned electronic equipment. Nashua. Bureau of Naval Weapons.

14—North American Aviation, Columbus, Ohio. $7,632,000. T-2B BUCKEYE aircraft. Columbus. Bureau of Naval Weapons.

—ITT Gilfillan, Inc., Los Angeles. $2,114,062. Service test model radar set, repair parts and engineering services. Los Angeles. Bureau of Ships.

16—Lear Siegler, Inc., Anaheim, Calif. $1,799,158. Anti-submarine warfare instrumentation system. Anaheim. Navy Purchasing Office, Los Angeles.

17—General Electric, Schenectady, N.Y. $2,050,900. Design and furnish reactor plant equipment for naval nuclear powered ships. Schenectady. Bureau of Ships.

—Master Mfg. Co., Hutchinson, Kan. $2,095,000. Ordnance production line equipment. Hutchinson. Navy Air Engineering Center, Philadelphia.

—Sperry Gyroscope Co., Syosset, N.Y. $1,850,000. Development of instrumentation & control subsystem for the nuclear powered deep submergency research and ocean engineering vehicle (NR-1). Syosset. Special Projects Office.

—General Instrument, Inc., Hicksville, N.Y. $3,148,050. Classified electronics equipment. Hicksville. Bureau of Ships.

—Westinghouse Electric Corp., Washington, D.C. $3,740,899. Steam turbine generator sets for naval ships. Sunnyvale, Calif. Bureau of Ships.

20—Gyrodyne Company of America, St. James, N.Y. $1,000,000. Long lead time items for QH-50D helicopters. St. James. Bureau of Naval Weapons.

21—RCA, Camden, N.J. $5,000,000. Radio sets and associated parts. Camden. Bureau of Ships.

—Motorola, Inc., Military Electronics Div., Scottsdale, Ariz. $4,406,018. Guidance & control systems for the SIDEWINDER missile. Scottsdale. Bureau of Naval Weapons.

—Kearney & Trecker Corp., Milwaukee, Wis. $1,086,041. Tape controlled drilling, milling, tapping and boring machines for parts production of aircraft undergoing overhaul and repair. Milwaukee. Navy Purchasing Office, Washington, D.C.

22—Douglas Aircraft, Long Beach, Calif. $1,960,000. Production of A-4E and TA-4E aircraft. Long Beach. Bureau of Naval Weapons.

23—University of Washington, Seattle, Wash., Applied Physcis Lab. $2,474,000. Research & development in the field of underwater ordnance. Seattle. Bureau of Naval Weapons.

—Bendix Corp., Eclipse Pioneer Div., Teterboro, N.J. $3,175,000. Amplifiers and computers used in navigational computer sets on board Navy Aircraft. Teterboro. Navy Aviation Supply Office, Philadelphia.

27—Honeywell, Inc., Minneapolis, Minn. $42,573,742. Production of MK 46 MOD 1 torpedoes. Hopkins, Minn. Bureau of Naval Weapons.

—Aerojet General Corp., Azusa, Calif. $64,965,121. Production of MK 46 MOD 1 torpedoes. Azusa. Bureau of Naval Weapons.

—Todd Shipyards, Seattle, Wash. $3,883,000. Activation of ammunition ship USS VIRGO (AE-30). Seattle. Thirteenth Naval District.

—Williamette Iron & Steel Corp., Portland, Ore. $3,784,000. Activation of ammunition ship USS CHARA (AE-31). Portland. Thirteenth Naval District.

—New York Shipbuilding Corp., Camden, N.J. $2,869,000. Activation and repair of the landing ships, tank, USS CLARKE COUNTY (LST-601) and USS COCONINO COUNTY (LST-603). Camden. Fourth Naval District.

—Bethlehem Steel Corp., Baltimore. $3,028,388. Activation and repair of the landing ships, tank, USS BULLOCH COUNTY (LST-509) and USS MEEKER COUNTY (LST-980). Baltimore. Fourth Naval District.

—Raytheon Corp., Lexington, Mass. $4,250,830. Guidance and control systems for SIDEWINDER missiles. Lowell, Mass. Bureau of Naval Weapons.

28—General Electric, Schenectady, N.Y. $1,932,950. Design and furnish support equipment for nuclear-powered ships. Schenectady. Bureau of Ships.

—Sperry Gyroscope Co., Sperry Rand Corp., Great Neck, N.Y. $11,701,999. Inertial navigation systems and associated items for use aboard Navy ships. Great Neck. Bureau of Ships.

—Stewart-Warner Corp., Chicago. $6,189,169. Radio transmitter-receivers for shipboard use. Chicago. Bureau of Ships.

—National Steel & Shipbuilding Co., San Diego, Calif. $21,492,000. Construction of a combat store ship (AFS). San Diego. Bureau of Ships.

29—Westinghouse Electric, Baltimore, Md. $2,177,280. Advanced development model of an anti-submarine warfare radar. Baltimore. Bureau of Ships.

—Westinghouse Electric, Aerospace Div., Baltimore, Md. $1,547,047. Airborne control system for F-4H PHANTOM aircraft. Baltimore. Bureau of Naval Weapons.

—Goodyear Aerospace Corp., Akron, Ohio. $4,598,061. Production unit of the A-6A Weapon System Trainer. Akron. Naval Training Device Center, Port Washington, N.Y.

30—Sperry Gyroscope Co., Syosett, N.Y. $1,587,800. Refresher maintenance training laboratories. Syosett. Navy Special Projects Office.

—Collins Radio Co., Cedar Rapids, Iowa. $10,110,325. Series of integrated electronic controls for the U.S. Navy, U.S. Air Force and the United Kingdom. Cedar Rapids. Bureau of Naval Weapons.

AIR FORCE

1—Sylvania Electric Products, Waltham, Mass. $1,206,806. Fabrication of a MINUTEMAN ground electronics system. Waltham. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—General Dynamics, San Diego, Calif. $1,168,000. Studies and evaluations applicable to anti-missile research. San Diego. Air Force Special Weapons Center (AFSC), Kirtland AFB, N.M.

2—AVCO Corp., Stratford, Conn. $11,962,122. T-53 engines for Army aircraft. Stratford. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—AVCO Corp., Wilmington, Mass. $1,600,000. Design, development, fabrication, test and evaluation of MINUTEMAN MARK 11A re-entry vehicles. Wilmington. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

3—Sanders Associates, Inc., Bedford, Mass. $1,575,350. Development of aircraft ordnance fuzes. Bedford. Electronic Systems Div. (AFSC), L. G. Hanscom Field, Mass.

6—Teledyne Industries, Garland, Tex. $1,040,000. Production of seismometers. Garland. Middletown Air Materiel Area (AFLC), Olmsted AFB, Pa.

—General Dynamics, Fort Worth, Tex. $1,950,000. Modification of the B-58 flight control system. Fort Worth. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—Collins Radio Co., Dallas, Tex. $2,955,000. Airborne communications antenna systems for C-135 aircraft. Dallas. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

7—Aerodex, Inc., Miami, Fla. $6,504,139. Overhaul of R-4360 aircraft engines. Miami. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex.

8—AVCO Corp., Cincinnati, Ohio. $10,500,000. Equipment for early warning systems. Cincinnati. Electronic System Div. (AFSC), L. G. Hanscom Field, Mass.

—General Motors, Indianapolis, Ind. $1,682,819. Modification of C-131 aircraft. Indianapolis. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex.

9—Cutler-Hammer, Inc., Deer Park, N.Y. $1,057,250. Spare parts for airborne reconnaissance systems. Deer Park. Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga.

10—Thiokol Chemical Corp., Bristol, Pa. $1,000,000. R&D of Stage I motors for MINUTEMAN Wing VI. Brigham City, Utah. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—I.B.M. Corp., Washington, D.C. $1,660,483. Electronic data processing components. Poughkeepsie, N.Y. 2750th Air Base Wing (AFLC), Wright-Patterson AFB, Ohio.

—**Ford Motor Co.**, Newport Beach, Calif. $1,140,000. Test and evaluation of missile fuzing and arming systems. Newport Beach. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

13—**Martin-Marietta**, Baltimore, Md. $1,235,000. Modification of B–57 aircraft. Baltimore. Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga.

—**Westinghouse Electric**, Baltimore, Md. $1,858,000. Modification of search and height finder radar. Baltimore. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Okla.

14—**Stewart Stevenson Services**, Houston, Tex. $1,351,302. Production of electric power generators. Houston. Sacramento Air Materiel Area (AFLC), McClellan AFB, Calif.

15—**Sylvania Electric Products**, Waltham, Mass. $2,400,000. Work on ground electronics system for MINUTEMAN Wing VI. Waltham and Needham, Mass. and Buffalo, N.Y. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

16—**Textron, Inc.**, Belmont, Calif. $1,486,361. Cable test sets and adapter assemblies. Belmont. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Sperry Rand Corp.**, Phoenix, Ariz. $1,188,055. Procurement of an automatic flight control system. Phoenix. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**General Electric Co.**, Waynesboro, Va. $1,843,884. Procurement of C–141 aircraft Electrical Systems. Waynesboro. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Sperry Rand Corp.**, Great Neck, N.Y. $1,814,985. Procurement of components, spare parts, areospace ground equipment and updating kits for LORAN navigation sets. Great Neck. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

17—**I.B.M.**, Washington, D.C. $1,210,375. Production of electronic data processing equipment. Poughkeepsie, N.Y. 2750th Air Base Wing (AFLC), Wright-Patterson AFB, Ohio.

—**Honeywell, Inc.**, Hopkins, Minn. $1,488,758. Aircraft ordnance. Hopkins. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Analytical Services, Inc.** Falls Church, Va. $1,300,000. Analytical studies pertaining to the application of weapons systems. Falls Church. Air Force Office of Scientific Research, Washington, D.C.

—**Boeing Co.**, Wichita, Kan. $3,150,000. Modification of B–52 aircraft flight control systems. Wichita. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Okla.

21—**Federal Electric Corp.**, Richland, Wash. $2,907,649. MB–TEEN generator sets. Richland. Sacramento Air Materiel Area (AFLC), McClellan AFB, Calif.

—**Western Electric**, New York City. $1,500,000. Engineer services for the 490L communications system. New York City. Electronic Systems Div. (AFSC), L. G. Hanscom Field, Mass.

—**F&M Systems Co.**, Dallas, Tex. $1,249,845. Engineering, furnishing and installing TV facilities in mobile recorder vans. Dallas. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Okla.

—**Lockheed Aircraft Corp.**, Marietta, Ga. $1,363,327,000. Development and production of the C–5A heavy transport aircraft. Marietta. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

22—**Lear Siegler, Inc.**, Data & Controls Div., Long Island City, N.Y. $1,512,994. Production of radar equipment. Long Island City. Electronics Systems Div. (AFSC), L. G. Hanscom Field, Mass.

—**General Electric Co.**, Re-entry Systems Dept., Philadelphia. $4,100,000. Research & development on the MARK 12 re-entry system. Philadelphia. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Tumpane Co.**, Los Angeles. $1,907,499. Performance of annual maintenance and operations services at Los Angeles Air Force Station, El Segundo. Space Systems Div. (AFSC), Los Angeles.

—**Houston Fearless Corp.**, Los Angeles. $1,993,000. Production of photographic processing and interpretation equipment. Los Angeles. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

27—**Philco Corp.**, Western Development Laboratories, Palo Alto, Calif. $1,000,000. Satellite control network. Palo Alto. Space Systems Div. (AFSC), Los Angeles.

—**Cubic Corp.**, San Diego, Calif. $1,731,761. Modification of geodetic survey microwave equipment. San Diego. Warner-Robins Air Materiel Area (AFLC), Robins AFB, Ga.

28—**North American Aviation**, Anaheim, Calif. $1,108,000. Maintenance and repair of MINUTEMAN guidance and control equipment. Anaheim. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Aerojet-General Corp.**, Sacramento, Calif. $2,066,537. Maintenance and acceptance testing of TITAN II propulsion systems. Sacramento. Ogden Air Materiel Area (AFLC), Hill AFB, Utah.

—**Dow Chemical Co.**, Midland, Mich. $2,055,826. Production of aircraft ordnance. Torrance, Calif. Ogden Air Materiel Area (AFLC), Hill AFB, Utah.

—**AVCO Corp.**, Stratford, Conn. $28,283,869. Production of T–55 aircraft engines. Stratford. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

29—**General Electric**, Philadelphia. $2,000,000. Flight testing of the Maneuvering Ballistic Re-entry Vehicle. Philadelphia. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**RCA**, Defense Electronic Products, Moorestown, N.J. $5,052,500. Depot level maintenance & supply support for instrumentation radars. Moorestown. Air Force Eastern Test Range, Patrick AFB, Fla.

—**Libby Welding Co.**, Kansas City, Mo. $2,197,183. 10 kilowatt generator sets with spare parts and related data. Kansas City. Sacramento Air Materiel Area (AFLC), McClelland AFB, Calif.

—**General Precision, Inc.**, Binghampton, N.Y. $2,567,000. F–111 mission simulators. Binghamton. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Garrett Corp.**, Los Angeles. $1,365,438. Spare parts to support the central air data computer on F–4 aircraft. Los Angeles. Middletown Air Materiel Area (AFLC), Olmstead AFB, Pa.

—**Emerson Electric Co.**, Electronics & Space Div., St. Louis. $2,535,000. Automatic test equipment for F–111 aircraft and MINUTEMAN missile systems. St. Louis. Middletown Air Materiel Area (AFLC), Olmstead AFB, Pa.

—**Cleveland Pneumatic Tool Co.**, Cleveland, Ohio. $1,881,230. Truck assemblies applicable to KC–135 aircraft. Cleveland. Ogden Air Materiel Area (AFLC), Hill AFB, Utah.

—**Honeywell, Inc.**, Hopkins, Minn. $4,115,992. Development of a tactical fighter munition dispenser. Hopkins. Air Proving Ground Center, Eglin AFB, Fla.

—**General Precision, Inc.**, Little Falls, N.J. $5,200,000. Components for navigational computer sets and aerospace ground equipment for C–141 aircraft. San Marcos, Calif. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**General Dynamics Corp.**, San Diego, Calif. $1,655,299. Design & fabrication of re-entry vehicle instrumentation and range safety systems. San Diego. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Thiokol Chemical Corp.**, Huntsville, Ala. $2,000,000. Solid rocket motors. Huntsville. Space Systems Div. (AFSC), Los Angeles.

From The Speakers' Rostrum

(Continued from Page 16)

be selected. Each country will get full data on the work done by the other country's contractor and the rights for production. The main difference arises with respect to royalties. We will be obligated to pay Rolls-Royce, for production for our own defense purposes, "fair and reasonable" royalties for their background work on lift engines pertinent to the engine design produced. The converse is true for Rolls-Royce's production for British defense purposes.

• **Will sales be competitive?** Yes, each contractor will be entitled to compete for the inventory requirements of the other country and for sales to third parties. In addition to separate bids, the two contractors can also submit joint production bids.

• **Will there be "industrial compatibility?"** We believe so. We know of Rolls-Royce interest in the project, to the extent that Rolls will be contributing a part of the UK share of the cost. We believe that we have provided the winning U.S. contractor and Rolls a sufficiently attractive and practicable program for them to be able to work out a mutually satisfactory commercial agreement.

Conclusion.

This has been a brief summary of what we have been doing up to now in cooperation in the development of military aircraft. In conclusion, allow me to forecast some trends that increased cooperation should bring about in the next four years:

• There will be closer working ties between the technical and military elements of our different governments.

• There will be a higher degree of integration of the aerospace industries of the several countries.

• There will be general acceptance of the business framework for development cooperation.

• And last, there will be more joint meetings of technical societies such as this one.

DEFENSE PRIME CONTRACT AWARDS TO SMALL BUSINESS

(Amounts in Thousands)

	July-Oct. 1965	July-Oct. 1964
Procurement from All Firms	$10,133,387	$8,338,778
Procurement from Small Business Firms	2,072,309	1,686,048
Percent Small Business	20.5	20.2

Formal Advertising Results in Increased Procurement Competition

The Department of Defense has increased competitive procurements by formal advertising from 11.9 percent of total dollars awarded in FY 1961 to 17.6 percent in FY 1965. The FY 1965 ratio for formal advertising procurements is the highest ever attained by DOD.

During the same period, DOD increased overall competitive procurements from 32.9 percent of total dollars awarded in FY 1961 to 43.4 percent in FY 1965.

A substantial part of this achievement is attributed to increased use of a procedure known as two-step formal advertising in the past several years. The percentage of formal advertising awards utilizing this method has increased from 2.4 percent in FY 1962 to 15.1 percent in FY 1965. In dollars, two-step formal advertising awards increased from $85 million in FY 1962 to $726 million in FY 1965.

Adopted in FY 1961, the two-step formal advertising procedure requires reasonable assurance of enough qualified firms interested in bidding to insure adequate price competition. In the first step, technical proposals are submitted by the bidders to determine technical competence and, in the second step, prices are submitted by qualified firms. Experience with the two-step method shows that it frequently can be used in cases where procurements otherwise would have to be negotiated.

The traditional method of advertising procurements for military supplies has been to publicize formally the intention to buy certain items and solicit offers from suppliers to sell them. Contracts are awarded by accepting the lowest prices from qualified suppliers.

The two-step procedure does not overcome all obstacles to increasing the formal advertising percentage of procurements. For example, the procurements set aside for small business firms and labor surplus areas do not lend themselves to such a procedure. Also, negotiation will continue to be required for much research and development procurement, for many complex weapons systems and in those instances where a high security classification is necessary to avoid disclosure of important development.

Nevertheless, the Defense Department will continue its efforts to increase formal advertising awards, particularly by increased use of the two-step method of advertising.

NASA Publishes Aerospace Dictionary

A dictionary which defines some 7,000 technical terms now being used by scientists engaged in aerospace research and development has been published by the National Aeronautics and Space Administration.

The new reference book is designed for use by persons with scientific or engineering educations who are interested in fields outside their own specialties. Each definition is intended to be as clear as possible to the nonexpert.

Whenever possible, an operational definition is used, i.e., one which defines a concept in terms of actual operations by which the defined quantity can be measured rather than in terms of properties. Many definitions have been adapted from definitions accepted by Government agencies, scientific and technical societies and national and international organizations.

The publication, titled "Dictionary of Technical Terms for Aerospace Use," is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402, for $3.

Readers of this first edition are invited to submit suggested changes, corrections or refinements of definitions to improve subsequent editions.